

A Physiological Comparison between Mindfulness and Cognitive Reappraisal

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Abstract

An increasing number of diverse therapeutic techniques are being prescribed to deal with distress, and some techniques ask individuals to engage in quite different forms of coping. While mindfulness and cognitive changes techniques both have research backing to suggest that they effectively promote actively approaching distress and promote change through greater control, they are rarely compared to one another empirically. The current study is a step in the direction of systemic physiological comparison between mindfulness and cognitive modification as methods of coping with stress during stress versus recovery. Eighty-four participants were randomly assigned to one of three conditions—observe/describe, acceptance, and reappraisal. Participants were instructed to write about a past sad life event and to evoke physiological reactivity, and then they were asked cope with their distress using the technique they were assigned. As dependent measures, blood pressure, heart rate, and respiratory sinus arrhythmia (RSA) were collected. Differences between conditions during coping and recovery were examined. Overall, results indicated that there were not significant differences between the three conditions during coping or recovery. Only one statistically significant effect was discovered between conditions, which is not enough evidence to suggest the conditions are distinct enough to warrant clinical attention. Results are discussed in light of the fact that there has been limited research conducted comparing the two theoretical approaches utilizing physiological data.

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A Physiological Comparison between Mindfulness and Cognitive Reappraisal

Diverse theoretical perspectives advise clients to view and manipulate internal thoughts, emotions, and sensations in very different ways. For example, mindful observation of ongoing experiences encourages the understanding that unpleasantness can be tolerated and constructive choices can be made about how to respond effectively—regardless of what emotions and thoughts are present. Instead of taking active attempts to change the content of thoughts or emotions, mindfulness teaches individuals' to see these experiences as transitory mental events passing through awareness and to be open and *accepting* to whatever sensations arise (Segal, Williams, & Teasdale, 2002; Shapiro, Carlson, Astin, & Freedman, 2006). The relationship between the individual and their thoughts is challenged rather than the actual content (Hayes, Strosahl, & Wilson, 1999). Researchers have suggested that mindfulness acts as a form of exposure in that it increases tolerance for negative sensations, cognitions, and emotions (Lynch, Chapman, Rosenthal, Kuo, & Linehan, 2006).

In contrast, cognitive-behavioral approaches to thoughts and emotions teach individuals to generate rational alternatives to their irrational responses (Beck, 1975; Beck, 1993; Ellis, 1975, 2001). Cognitive therapists teach clients to identify their automatic thoughts—which are those thoughts that intervene between external events and the individuals' emotional reactions to them (Young, Rygh, Weinberger, & Beck, 2008). Therapists assume that often times these automatic thoughts are a part of a client's ingrained, habitual patterns and therefore an effort is made to discover the thoughts that precede emotions such as anger, sadness, and fear. Once the automatic, often times dysfunctional thoughts are generated, the client is asked to approach the thought as a testable hypothesis. The hypothesis is then weighed in with evidence for and against. However, researchers have noted that one of the most difficult steps in cognitive-

behavior therapy (CBT) is substituting irrational thoughts with rational ones (Hofmann & Asmundson, 2008) because automatic thoughts are like habits that are resistant to change. CBT approaches *encourage* judging the extent to which thoughts are rational, realistic, or logical and correct cognitions if they are illogical—the model purports that unwarranted emotional responses are due to unrealistic assessments of situations. Therefore, cognitive approaches advise clients to change the content of their thoughts.

Even though these two clinical approaches are very different, therapists use both of them as empirically supported emotional regulation (ER) techniques. Moses & Barlow (2006) proposed that effective ER interventions should address three areas of emotional dysfunction, including preventing experiential avoidance of emotions; changing action tendencies associated with the disordered emotion; and restructuring maladaptive cognitive appraisals. While ER research is at its infancy, the umbrella term subsumes mindfulness and cognitive-behavioral approaches in a way that allows for both to be taught together. However, while mindfulness and CBT researchers' are quick to critique one another (e.g. Hayes, 2008; Hofmann, 2008), very little empirical research has compared these approaches.

Research suggests that change-based strategies account for no additional variance in predicting psychological symptoms after acceptance-based strategies are accounted for (Sauer & Baer, 2009). In addition, a pilot study compared mindfulness-based stress reduction (MBSR) to cognitive behavior stress reduction and found that the MBSR group had significantly greater improvement across all outcomes (Smith, et al., 2008). However, cognitive therapists are not publishing studies comparing their theory and treatment protocols to mindfulness approaches. This may be due in part to the fact that Beck developed cognitive therapy over 40 years ago and it has received a tremendous amount of empirical study, validation, and clinical application for a

wide variety of disorders (Young, Rygh, Weinberger, & Beck, 2008). Unlike mindfulness-based approaches, CBT systemically helps clients develop a new associative network of adaptive thoughts and behaviors to compete with maladaptive networks and memories (Foa & Kozack, 1986; Arch & Craske, 2008). CBT also uses cognitive restructuring as a way to deal directly with surface level threat appraisals to modify deeper, more entrenched biases and reframing has been empirically shown to decrease the intensity and behavioral expression of negative emotions (Gross, 2002). Also, CBT has strong evidence suggesting that it enhances prediction and control—both of which are known to predictive positive coping and mental health (Skinner, 1995). What is currently unknown, however, is which method (mindfulness or CBT) leads to greater prediction and control of mental phenomena. Therefore, while there is some preliminary research that mindfulness forms of acceptance are superior to change-based strategies, mindfulness and cognitive change strategies have not been compared at a physiological level. Research is needed to better understand which coping techniques offer the most relief both psychologically **and** physiologically. This study's proposed goal is to compare the two techniques through a physiological perspective.

This project employed a sad-mood inducing writing task and physiological measurement tools to examine whether individuals assigned to either mindfulness based or cognitive reappraisal conditions exhibit different physiological responses. The current study's goal was to partial out the effects of acceptance and change-based processes in the context of dealing with difficult emotions, thoughts, and sensations. Before detailing the current research, the relevant context from which it emerges is reviewed. First, psychological evidence for mindfulness and acceptance based strategies are discussed. Next, evidence is reviewed regarding cognitive reappraisal. Then, relevant physiological background information is reviewed. The physiological

indicator of most interest in the proposed study is parasympathetic functioning. In particular, one physiological indicator of parasympathetic functioning, high frequency heart rate variability (HF HRV), and its important relationship to stress and coping will be reviewed in the context of mindfulness and cognitive-based change. The two different approaches will be compared and contrasted throughout. The introduction provides a framework for understanding why the current study is a step in the right direction to understanding the relative strengths and/or weakness of coping through mindfulness and cognitive change techniques. Hofmann, Sawyer, Witt, and Oh (2010) called for an exploration of these two theoretical approaches and recognized that although it is difficult to test entire treatment protocols against each other, a step in the right direction is to isolated specific techniques in the lab environment.

Mindfulness-Based Approaches to Distress

Mindfulness research is a relatively new area of empirical research and the current definition and its implications in psychological functioning is just now beginning to be empirically tested. This section is written in a factual manner in which theoretical assumptions are used, with an understanding that some assumptions have and have not been empirically tested. Mindfulness is conceptualized as a way of paying attention and being aware of what is taking place in the present moment. The observation or awareness of internal and external experiences is done in a non-judgmental, accepting, and open way. “In mindfulness practice, the focus of a person’s attention is opened to admit whatever enters experience, while at the same time, a stance of kindly curiosity allows the person to investigate whatever appears, without falling pretty to automatic judgments or reactivity.” (Segal, et al., 2002, p.322-323).

As a result of increased present moment attention, clients notice the positive with increased richness and vividness. As negative thoughts, emotions, and sensations are non-judgmentally accepted and observed, habitual reactivity tendencies are decreased and clients begin to notice a pause whereby they can choose how to respond to distress in novel ways. The goal is not to decrease the sheer number of negative thoughts, but to increase the ability to observe thoughts and feelings without necessarily acting in accordance with them. This allows individuals' to behave consistently with goals and values, even when they do not *feel* like it (Brown, Ryan, & Creswell, 2007). This leads the client down a path of noticing relationships between their thoughts, feelings and behaviors. Furthermore, this core principle has been tagged as changing the stimulus functions of internal experiences—in that thoughts and feelings do not have to lead to specific behaviors.

Mindfulness teaches a paradoxical way of seeking control in which all sensations (both positive and negative) are observed and accepted for what they are (Bishop, et al., 2004). There is no need to immediately react or put forth wasted energy in changing the experience, because the distance between oneself and the stimulus is what is important. The mindful-pause allows for a step back and then re-engagement with meaningful activities. One study compared complete cognitive therapy, partial cognitive therapy, and a distancing technique in which patients were asked to “distance” themselves from thoughts and not to modify the content of their thoughts (Zettle & Rains, 1989). The distancing technique is very similar to mindfulness methodology, and distancing group showed a significantly greater reduction in depression symptoms compared to the other two groups.

Mindfulness cultivates a particular relationship with sensations, cognitions, and emotions in which they are seen as transitory mental events passing through awareness that are not

necessarily important or literally true and do not require particular behaviors in response. This perspective of internal experiences is called decentering or re-perceiving (Segal, et al., 2002; Shapiro, et al., 2006). Adopting this stance encourages the understanding that one can choose how to respond to transient thoughts and emotions. Control is therefore paradoxically gained through letting go and experiencing each moment deeply without identification, clinging, or reacting automatically. Through a mindful stance one is able to choose when to be absorbed in thoughts and when to decenter. Decentering reduces the usual automatic connections between internal experiences and subsequent behavior. One result of these new insights about the relationships between thoughts, impulses, feelings, and behavior may be improved self-control (Bowlin & Baer, 2012; Evans, Baer, & Segerstrom, 2009; Leary, Adams, & Tate, 2006).

The psychological freedom and flexibility that is gained through acceptance may lead to increasing amounts of control and mastery of one's environment. Consistent with all of these stated assumptions, mindfulness-based cognitive therapy researchers (Teasdale, et al., 2002) provided evidence that it's possible to alter the function of thoughts without first altering their form. In addition, several reviews of the literature support the use of acceptance and mindfulness based treatment approaches for a wide range of problems and disorders, which will be reviewed briefly later in this introduction (Baer, 2003; Grossman, Neimann, Schmidt, & Walach, 2004; Hayes, Masuda, Bisset, Luoma, & Guerrero, 2004; Robins & Chapman, 2004).

Cognitive Behavioral Approaches to Distress

Theorists have argued that the self-perpetuating cycle of cognitively reacting to challenging thoughts, sensations, and emotions strengthens the reaction and salience of the threat. Therefore, cognitive therapists believe that the best way to stop the cycle is through conscious consideration and re-evaluation of maladaptive thoughts (Beck, Emery, & Greenberg,

1985; Clark, 1986). Cognitive Behavioral Therapy (CBT) teaches cognitive restructuring, which deals directly with surface-level appraisals and modification of automatic negative thoughts, which has been empirically researched and found to play a central role in emotional vulnerability (MacLeod, Campbell, Rutherford, & Wilson, 2004; MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002; Mogg & Bradley, 1999). Similarly, researchers have found that reinterpreting or challenging the validity of thoughts leads to reduction in the frequency and intensity of negative emotions and is associated with fewer symptoms of depression (Gross & John, 2003). For example, clients may generate a log of problematic situations, corresponding moods, and automatic thoughts or images. Then, they are instructed to apply Socratic questioning and produce evidence for particular thoughts by writing factual support for and against thought. Alternative, balancing thoughts are also explored by asking the client alternative ways to view the situation, and in turn they may notice how their mood shifted after viewing the situation differently.

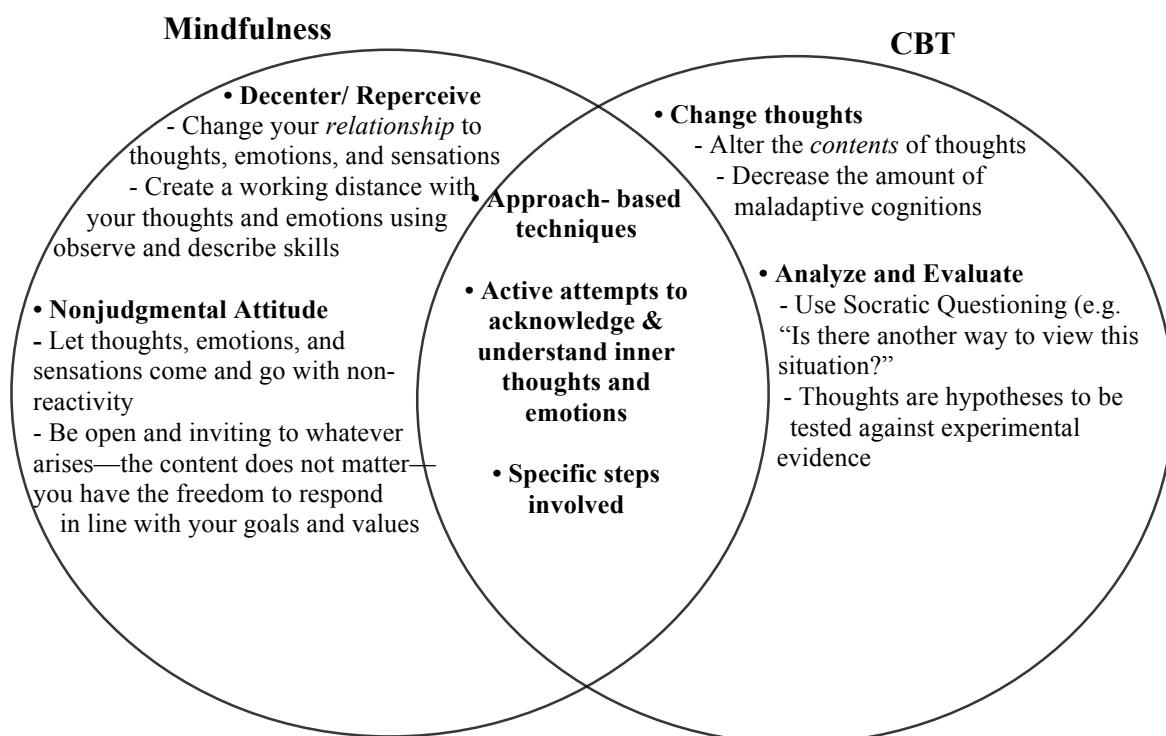
CBT also teaches clients to engage in pleasant activities and positive events as a means to take their mind off unwanted thoughts and emotions (Nolen-Hoeksema & Morrow, 1993; Reynolds & Wells, 1999). Another change based process inherent to the CBT tradition is modifying distorted thoughts and engaging in positive self-talk, which promotes a more balanced outlook to counterbalance the negative emotions (Salovey, Mayer, Goldman, Turvey, & Palfai, 1995). Both of these strategies, which emphasize modifying distorted thoughts and engaging in positive self-affirming talk and positive activities as a means to improving mood are changed-based strategies that have been associated with symptom reduction in clinical samples (Butler, Chapman, Forman, & Beck, 2006).

Cognitive restructuring challenges the assumption that thoughts are facts by proposing that thoughts are hypotheses to be tested against experiential evidence. Therefore, cognitive reframing is thought to suspend rumination by returning the client to the situational context in which their automatic thoughts arose (Arch & Craske, 2008). In addition, CBT incorporates strategies that specifically aim to increase a sense of predictability and control. For example, self-monitoring of maladaptive thought patterns, symptoms, and environmental triggers. Then, steps are taken to change the actual contents of their thoughts, and clients are taught that this form of restructuring will change their corresponding emotions and reactions. The sense of control that CBT promotes is thought to be another mechanism of change, and there is evidence that perceived control is more valuable and more predictive of positive treatment outcomes, positive coping, and mental health than actual control (Mineka & Hendersen, 1985; Skinner, 1995). Consistent with these tenets, there is also strong evidence to suggest that prediction and control are central to the regulation of fear and to the etiology and maintenance of distress (Barlow, 2002; Bouton, 2002; Bouton, Mineka, & Barlow, 2001; Craske, 2003). Furthermore, perceived control is related to lower levels of psychopathology in psychiatric inpatients (Lang & McNiel, 2006). CBT researchers propose that the mechanisms of change range from reductions in the number of negative thoughts and worries, modification of maladaptive beliefs and schemas, increased perceived control over symptoms, and reductions in behavioral avoidance (for a review see Garratt, Ingram, Rand, & Sawalani, 2007).

However, the cognitive components, when studied separately from the behavioral components have not been found to significantly improve the outcome of behavioral therapy (Longmore & Worrell, 2007b), and this finding has led several to conclude that the cognitive components of CBT are unnecessary (Hayes, 2004; Longmore & Worrell, 2007a). For example,

the response to traditional cognitive-behavioral therapy often occurs before cognitive change techniques have been implemented (Ilardi & Craighead, 1994). Specifically, behavioral activation techniques, such as promoting social-engagement and engagement in avoided activities, are frequently taught prior to cognitive techniques. During this beginning phase of treatment, rather dramatic changes are seen and researchers propose that the major gains in symptom reduction are driven by behavior change rather than cognitive-mediation (Ilardi & Craighead, 1994). Furthermore, cognitive mediation of treatment outcomes has been found in the absence of explicit cognitive strategies for behavioral therapy groups (Hofmann, 2004; Smits et al, 2006). Therefore, researchers and clinicians must keep in mind that CBT may be targeting behavioral change and not cognition. If this is the case, the control gained by altering cognitions may not be as salient as cognitive theorists purport.

The diagram located below breaks apart the conceptual assumptions and differences between mindfulness and cognitive-behavioral therapy as well as the similarities. Throughout the following sections, the differences and similarities are discussed.



Similarities and Differences between Mindfulness and CBT

If we take it as fact that both mindfulness and cognitive change promote actively approaching distress and promote change through greater control, then we need to distill which method is more effective. If treatments that do not explicitly target cognitions are in fact changing cognitions over time, then our efforts to change cognitions through reappraisal and manipulation of one's ongoing experience may be unnecessary. Furthermore, believing that one must control and respond to thoughts, sensations, and emotions through changed-based processes may lead to increasingly limited opportunities for experiencing sensations, thoughts, and emotions and the flexibility of responding to them. However, if changing cognitions leads to increased perceptions of control and this makes individuals actually gain more control, then it makes sense to continue to teach cognitive techniques. Evidence suggests that active attempts to acknowledge, understand, and express emotions are associated with attenuated distress in stressful circumstances and greater wellbeing (Austenfeld & Stanton, 2004; Stanton, Kirk, Cameron, & Danoff-Burg, 2000). Both techniques purport to increase awareness and processing of thoughts, emotions, and challenging situations and are approach-based forms of coping. The question is—which method creates a more active, accepting, and understanding internal environment to help foster growth and change?

Whereas cognitive strategies are more interested in changing the content of thoughts, mindfulness targets the relationship or attachment the individual has with their thoughts and emotions. Some mindfulness researchers suggest that cognitive restructuring in CBT focuses too greatly on the content of cognition, thereby keeping the ruminative cycle alive (Eifert & Forsyth, 2005; Roemer & Orsillo, 2002). Furthermore, countering thoughts with judging and modifying thought content may require additional, unnecessary effort and may even intensify the struggle to

rid oneself of the distressing content. In support of this concept, Sauer & Baer (2009) found through a hierarchical regression analysis that change-based strategies accounted for no additional variance in predicting psychological symptoms and very little additional variance in predicting psychological wellbeing, after frequency of internal experiences and acceptance-based strategies were accounted for. In the same study, Sauer & Baer (2009) found support for both a mindfulness stance toward unwanted stimuli (cognitions, emotions, bodily sensations) and the use of reappraisal in that both were associated with reduced symptoms and greater wellbeing. However, the hierarchical test that showed the insignificance of change-based strategies, after acceptance-based strategies were accounted for, suggests that mindfulness techniques may be superior.

Conceptually these two methods of treatment diverge in the mechanism used for creating increased control over thought patterns and emotions. While some theoretical evidence suggests that mindfulness and acceptance-based coping techniques may be superior in reducing symptoms and increasing psychological wellbeing, the answer of which one is “*better*” is currently widely debated and evidence is still unclear (Arch & Craske, 2008; Smith, et al., 2008). Several questions, beyond the scope of the current study also exist, including whether mindfulness is more effective as a relapse prevention technique. Also, mindfulness may be a strategy that is better suited for relatively healthy populations while CBT may be a better approach for those suffering with clinical levels of distress. For example, Beck’s content-specificity hypothesis predicts that each emotional disorder can be characterized by specific cognitive content, and this is likely one of the main reasons why tailoring CBT techniques to different forms of psychopathology has been so successful (Hofmann, et al., 2010).

Physiological framework

The current study's goal was to compare the effects of mindfulness-based coping strategies and cognitive-change processes in the context of dealing with difficult emotions, thoughts, and sensations through physiological evidence. Physiological data helps us to understand which coping profile is healthier, and also provides a non-subjective dependent outcome. One possible pathway by which these different coping styles may influence health is via their influence on the body's physiological response during and following stressors. In the following section, physiological terminology and a background review of how the physiological outcome measures of interest are related to mindfulness and cognitive change is presented to set the context for measurements and goals of the current study.

An important theoretical backdrop that is important to take into consideration when comparing physiological profiles is the realization that physiological data is only one way of assessing psychological emotional-regulation strategies. Gross (1998) highlights that emotion begins with an evaluation of external or internal emotion cues in which behavioral, experiential, and physiological emotional response tendencies are recruited. These channels of experience all work together in order to facilitate adaptive responding to perceived challenges and opportunities. Emotions have been defined as multi-system patterned appraisals that lead to coordinated changes across behavioral, experiential, and physiological channels (Ekman, 1992; Levenson, 1994), also known as "emotion coherence". Surprisingly, Dan-Glauser & Gross (2013) point out that only two major studies have examined all three response- domains at the same time with the specific goal of assessing synchrony. In one study, Lang, Greenwald, Bradley, and Hamm (1993) used factor analytic statistics to show significant associations between expressiveness, valance, and heart rate. However, Mauus, Levenson, McCarter,

Wilhem, & Gross (2005) results revealed that physiological responses were only modestly associated with experience and behavior. This avenue of research highlights that it is false to assume that physiological parameters map onto self-report experiences of emotions and corresponding behavioral data. Therefore, to maintain a conservative approach in the current study, physiological data was the dependent variable of interest and conclusions regarding these emotion-regulation techniques and their behavioral and experiential components are not made.

Reactivity and recovery are important physiological responses that have both been shown to have health prognostic capabilities (Jennings, et al., 2004; Matthews, Salomon, Brady, & Allen, 2003). For example, they were found to be good predictors of future hypertension and related cardiovascular disease outcomes (Matthews, et al., 2004). Physiological stress reactivity, when tested in the lab, consists of an initial rest, or baseline period, followed by a period during which the participant is exposed to a stressor (for example, an arithmetic challenge). Accompanying physiological measurements record the consequent stress-related change, which is called reactivity (Linden, Earle, Gerin, & Christenfeld, 1997). Recovery may be defined as a post-stress rest period that documents information about the degree to which the stress response in the physiological marker being measured persists after the stressor has ended (Linden, et al., 1997). However, mindfulness and cognitive-based coping strategies and their associations with stress and recovery have not been examined. Specifically, mindfulness and cognitive change have not been compared to one another. Also, recovery information is rarely reported and stress reactivity levels are overemphasized in the literature to date.

There are several different physiological markers that can document reactivity and recovery responses given that stress involves the activity of multiple integrated neural and neuroendocrine systems. The branch of the autonomic nervous system of greatest interest in the

current study is the parasympathetic nervous system (PNS), the division of the nervous system responsible for rest and relaxation. For example, it has been shown to have an important role in decreasing heart rate and becoming more active during periods of safety, stability, and recovery from stress (Porges, 1995). PNS activation results in less wear and tear on the body, and it is not as metabolically costly as the slower responding sympathetic nervous system (Porges, 1998). Greater PNS input results in more pronounced acceleration and deceleration of respiration and more variable intervals between beats due to the rapid activity of the vagus nerve's metabolic control of the heart beat, also known as higher heart rate variability (HRV) (Berntson, Cacioppo, & Quigley, 1993; Somsen, Jennings, & Van Der Molen, 2004). HRV is a variable known to have important correlations with health outcomes, and is commonly reported as an index of PNS functioning. HRV, or the variance between the heartbeats, may be expressed as a function of frequency. This allows one to separate out the relative influences of the sympathetic and parasympathetic nervous system on the heart rate due to their differing temporal dynamics (Task Force, 1996). The high frequency band (.15-.40 Hz) is an index of PNS activity, while the low frequency band (.04-.15 Hz) reflects a more complex interplay of autonomic influence (Berntson, et al., 1997; Cohen, Matar, Kaplan, & Kotler, 1999; Eckberg, 1997).

Another way to report heart rate frequencies is by capturing patterns in respiration (also known as respiratory sinus arrhythmia, or RSA). The heart speeds up during inspiration and slows down after expiration. More parasympathetic input results in a more pronounced RSA. RSA and HF HRV are two widely acceptable markers of parasympathetic functioning (Berntson, et al., 1997; Cacioppo, et al., 1995). Throughout this paper, RSA and HRV will both be used to discuss HF HRV, depending on which one the author of the reference text used.

Regarding their health relevance, lower levels of HRV have been shown to predict sudden death, cardiovascular disease risk, mortality risk, as well as other morbidity outcomes (Algra, Tijssen, Roelandt, Pool, & Lubsen, 1993; Bigger, et al., 1992; Dekker, et al., 2000; Liao, et al., 1997; Tsuji, et al., 1994). PNS activity may offset the deleterious effects of sympathetic activity in cardiomyopathies or myocardial infarcts (Gang & Malik, 2002; Schwartz, La Rovere, & Vanoli, 1992; Smith, Kukiela, & Billman, 2005).

Psychologically, past research results suggest that higher HRV reflects a greater capacity for emotional regulation and the use of constructive coping (Appelhans & Luecken, 2006; Fabes & Eisenberg, 1997; Geisler & Kubiak, 2009). In addition, increases in HRV reflect increasing recruitment of self-regulatory usage over the course of a stressful task, which requires executive control. PNS activation usually requires mental effort and is often a matter of not acting and resisting the temptation to respond automatically (Segerstrom & Nes, 2007). Therefore, the use of the “vagal brake” reduces energy demands in the periphery, makes glucose available for the metabolic costs of mental effort, and promotes calm reflection (Fairclough & Houston, 2004; Porges, 2001). For example, individuals with higher resting HRV scored significantly higher on measures of active coping and acceptance and lower on more passive coping measures (O’Connor, Allen, & Kaszniak, 2002). Therefore, there is a consensus that higher HRV is related to more adaptive coping strategies. On the contrary, negative affective states, such as depression and anxiety have been tied to decreases in HRV (Cohen, et al., 1999; Friedman & Thayer, 1998; Vaccarino, et al., 2008). Maladaptive emotional regulation techniques are generally associated with inhibitory deficits, a lack of attention flexibility, and subsequent lower HRV (Berntson, Lozano, & Chen, 2005; Friedman & Thayer, 1998; Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008; Vaccarino, et al., 2008; Whitmer & Banich, 2007). Of particular relevance for the current

discussion, depressive rumination, a maladaptive response to sad emotion characterized by ruminative ideation focused on the causes, symptoms, and implications of one's depressive mood is related to lower HRV (Nolen-Hoeksema, 1991).

It is also important to keep in mind that HRV may be influenced by other psychological variables. For example, changes in affect and self-regulation influence HRV. Tasks that require more self-regulation and effort increase HRV (Segerstrom & Nes, 2007). In addition, HRV may decrease when stressful tasks result in affect change (Burleson, et al., 1998; Hughes & Stoney, 2000; Segerstrom & Nes, 2007). Although, some researchers have found no difference in changes in HRV based upon affective differences (e.g. Butler, Wilhelm, & Gross, 2006). Furthermore, when the task does not influence the individual affectively, HRV increases. However, self-regulation is a muscle that may be depleted over time (Baumeister, Vohs, & Tice, 2007). Self-regulatory effort and fatigue in Segerstrom and Nes' (2007) study resulted in later persistence deficits. If emotional regulation tasks are exceedingly difficult, over time they may fail. Therefore, stress regulation techniques that require a lot of effort over time, translated as very high HRV over an extended duration, may not be sustainable.

While it is adaptive to use more reflective regulation tactics during stressful times that require emotional constraint, experimental designs have provide compelling evidence for the presence of self-regulatory fatigue (Segerstrom & Nes, 2007). Regulating emotions during an event requires divided attention and therefore the regulation process of modifying thoughts, feelings, and behaviors may take additional attention resources (DePaulo, Blank, Swaim, & Hairfield, 1992; Wegner, 1994). By definition, regulating emotions involves self-regulation and takes considerable effort. In addition, learning a new skill requires larger amounts of self-regulation. Therefore, researchers should be cautious when comparing different coping

techniques to one another when one of the strategies is new to the participant. Different coping techniques experimentally induced should be designed to be as equally demanding as possible (matching in challenge and novelty).

In summary, the current study's dependent measure of outcome was RSA, as an index of emotion regulation and heart health. RSA is the optimal measure to use when capturing parasympathetic nervous system functioning, which is highly influential in emotional and self-regulation processes and thus makes most sense for this comparison study. In addition, given reactivity and recovery measures of RSA are typically not reported, the current study compared the trajectories of stress and recovery. Mindfulness and CBT forms of coping have never been compared before using physiological evidence, and therefore it is critical to break apart baseline functioning, reactivity, and recovery so that we are not simply capturing a snapshot of heart functioning. In addition, blood pressure and heart rate were collected simultaneously and are conceptualized as additional stress-reactivity measures.

Empirical studies assessing Cognitive Reappraisal and RSA

As mentioned, research indicates that HRV is associated with behaviors that require executive functioning. Executive functioning includes information updating and monitoring, inhibition of habitual response patterns, and mental task switching (Miyake, Friedman, Emerson, Witzki, & Howerter, 2000). Reappraisal is a form of emotion regulation that involves several of these executive functions and so it is thought to result in higher HRV. Research is just beginning to examine this association and to date there are less than a hand full of studies. In one study, cognitive reappraisal and expressive suppression were compared among 131 undergraduate women who viewed an anger-inducing video of a fellow student arguing for a position counter to that of the participant on an important political issue (Denson, Grisham, & Moulds, 2011).

Immediately prior to viewing the film, participants were asked to reappraise their experience, suppress their emotions, or simply watch the video as normal. Participants in the reappraisal condition showed increased HRV and those in the suppression and control conditions showed no increases in HRV. The authors interpreted the increased HRV as support for reappraisal as an adaptive emotion regulation strategy capable of producing greater autonomic flexibility in the context of anger-inducing events. This study relied on square root of the mean squared differences between successive R-R intervals (RMSSD) as a measure of high frequency HRV, and research support for RMSSD as a valid representation of the high frequency component of the respiratory frequency is not frequently reported because researchers are unsure about whether or not it truly represents HF HRV (Berntson, et al., 2005; Goedhart, Van der Sluis, Houtveen, Willemsen, & De Geus, 2007).

However, research that involves HRV as a dependent measure during acute laboratory manipulations is just beginning to flourish and several discrepant findings exist. For example, participants in one study experienced increased RSA following a film induction known to produce sadness, anger, and disgust when they were instructed to suppress their emotions or use reappraisal (Butler, Wilhelm, & Gross, 2006). The control participants in this study exhibited no changes in RSA. One important difference between the two conditions is that the suppression condition did not reduce negative emotions whereas the reappraisal condition did. The authors interpreted the corresponding increases in RSA for the reappraisal and suppression conditions as support for their hypothesis that RSA increases as a result from *any* attempt to increase emotional self-regulation. Given the inconsistent findings regarding the influence of changes in affect during emotional regulation, it remains unclear whether RSA changes are associated primarily with attention and cognitive processes involved in self-regulation in general, with

emotional changes that result from regulation, or both. However, the majority of research conducted in using RSA or HF HRV as a dependent outcome interprets heightened levels as more adaptive, regulated responses.

Empirical studies assessing Mindfulness and RSA

Mindfulness meditation and trait mindfulness have been reliably shown to increase parasympathetically-mediated RSA and HF HRV (Ditto, Eclache, & Goldman, 2006; Vest Rogers, 2009). Mindfulness has also been compared to relaxation treatment strategies to assess differences in both psychological and physiological outcomes pre-post intervention. For example, female university students who scored high on a worry questionnaire were randomly assigned to either a mindfulness or relaxation intervention. The program consisted of two weekly 1-hour group sessions over a five-week period. Participants underwent psychophysiological tests before and after the intervention including a rest period, a non-cued defense response paradigm that included intense white noise and emotionally latent pictures, and a self-induced worry period. In the post-intervention assessment, mindfulness or relaxation practice was added before the worry period. Mindfulness participants showed superior indices of respiratory parameters during resting, mindfulness/relaxation, and worry periods. Mindfulness participants also showed greater increases in meta-cognitive measures (e.g. attention to feelings, clarity and discrimination between feelings, and regulation of emotions). Both groups produced similar patterns of higher HF HRV during mindfulness/relaxation and lower variability during worrying versus resting periods. Also, both evidenced pre-post improvements in increasing HF HRV.

In a similar study, Ditto, et al. (2006) compared mindfulness meditation to other similar forms of relaxation, including progressive muscle relaxation and listening to an audio-recorded

novel. For both comparisons, participants displayed significantly greater increases in RSA while meditating than while engaging in the other relaxing activities. In addition, female participants exhibited a significantly larger decrease in diastolic blood pressure (BP) during meditation in comparison to the novel condition. Several other studies have also documented decreased BP (both systolic and diastolic) after participation in mindfulness-based therapy (e.g. Carlson et al., 2007; Rosenzweig et al., 2007).

An important finding from Ditto et al. (2006) is that the meditation practice produced decreases in pre-ejection period (PEP), which is indicative of increased cardiac sympathetic activity. Thus, increased sympathetic activity may explain the absence of their inability to find an effect of meditation on heart rate, which is consistent with a number of other investigators (Barnes, Treiber, Turner, Davis, & Strong, 1999; Jevning, Wilson, Smith, & Morton, 1978; Lehrer, Sasaki, & Saito, 1999; Peng, Henry, Mietus, & al., 2004). Increased sympathetic functioning does not negate the potential therapeutic effects of meditation, but the authors point out that it invites complexity to the issue and the importance of not viewing meditation as simply a state of rest (Holmes, Solomon, Cappel, & Greenberg, 1983). What was not discussed as a potential follow-up study, involves experimentally manipulating the different aspects of mindfulness (observing or present moment awareness and/or attitudes of non-judgment and acceptance). It is plausible that these different aspects of mindfulness contribute to physiological functioning in distinct ways. Evidence supports the view that meditation involves active, arousal-promoting processes as well as relaxing processes (Corby, Roth, Zarcone, & Kopell, 1978; Jevning, Wallace, & Beidebach, 1992). This study also provides compelling evidence for why more researchers should include parasympathetic markers in mindfulness studies.

In addition, it is advantageous to include a measure of reactivity and autonomic arousal in any study actively comparing two treatment modalities. Research indicates that in order for psychotherapy to be effective, the raw feelings should be felt within the therapeutic context. Furthermore, the ability to have autonomic responses to emotional states predicts antidepressant response in patients with MDD (Fraguas, et al., 2007). This is further support for the notion that in order for therapy to be effective, physiological arousal is an essential ingredient. In order for change to happen, acceptance and openness to distress may be critical. The more nuanced point is one of time sequencing, which is rarely targeted in research. One way of responding may be to experience raw emotions and physiological arousal for a period of time, followed by an increase in self-regulated physiological and emotional responses. However, there are theoretical disagreements regarding the beneficial effects of temporary emotional and physiological arousal during coping versus immediately controlling and regulating one's response. This discussion point is not addressed in the current study, given the goal of the current study is to describe the physiological differences between coping without making a judgment call as to which technique is superior.

Mindfulness training has also been linked to behavioral self-regulation outcomes. For example, participants in a mindfulness-based intervention study that exhibited increased HF HRV from resting baseline to meditation smoked fewer cigarettes at follow-up than those who exhibited acute decreases in HF HRV (Libby, Worhunsky, Pilver, & Brewer, 2012). However, mindful-responses to laboratory stressors have not been adequately researched and there are only a few published studies. In one study, Vest Rogers (2009) did not find a relation between trait mindfulness and HF HRV during a sad film clip. Another study found that higher trait mindfulness predicted lower cortisol responses (a stress-induced hormone), lower anxiety, and

negative affect to a social evaluative stress challenge, relative to a control task. These associations remained significant even after controlling for the role of other variables that also predicted cortisol and affective responses (e.g. fear of negative evaluation) (Brown, Weinstein, & Creswell, 2012).

Most of the research to date has focused on mindfulness forms of relaxation and their corresponding physiological effects and a few studies have examined effects of trait mindfulness on laboratory stressors. However, mindfulness instruction, administered as a tool to aid in approaching challenging emotions, is rarely studied as a stress-buffering mechanism under controlled laboratory conditions. Importantly, mindfulness is a set of skills that takes time and practice to learn, and this is probably why researchers have strayed away from teaching mindfulness and gather data in one session. Given mindfulness is a multifaceted concept, some researchers have isolated specific components of mindfulness and tested the effects of that specific component (e.g. observing and labeling internal experiences). For example, Creswell, Way, Eisenberger, and Lieberman (2007) measured participants dispositional levels of mindfulness and then participants completed an affect labeling task while undergoing functional magnetic resonance imaging. The labeling task consisted of matching facial expression to appropriate affect words. Dispositional mindfulness, after controlling for multiple individual differences, was associated with enhanced prefrontal cortical regulation of affect through labeling of negative affective stimuli. This is a great example of how mindfulness can be split into its subcomponents so that the laboratory task is manageable and requires little practice and familiarity with all of the components of mindfulness.

Similarly, the concept of accepting whatever emotions are present and being open to one's current experience has been isolated in a physiological reactivity study and was compared

to an evaluative emotional processing condition (Low, Stanton, & Bower, 2008). Across two experimental sessions, participants were randomly assigned to write about an ongoing stressful experience while either evaluating the appropriateness of their emotional response, attending to their emotions in an accepting way, or describing the objective details of the experience. Heart rate was assessed throughout and results suggested that writing about emotions in an evaluative way leads to less efficient heart rate habituation and recovery than processing them in an accepting or objective manner. The acceptance-oriented emotional processing produced HR responses that did not differ from the control condition, which involved focusing on the facts of the stressor. The authors concluded that habitually evaluating the appropriateness of one's emotional responses rather than accepting them as they unfold may have deleterious consequences for cardiovascular health, and interpreted their findings as support for mindfulness and acceptance based interventions (Low, Stanton, & Bower, 2008).

As highlighted in the research reviewed concerning mindfulness data and physiological functioning, mindfulness consists of several different sub-components. Just for clarity, the sub-components of mindfulness involved in the current study include present moment observation and an attitude of acceptance and non-judgment. The present moment attention and observation skills may increase or decrease physiological reactivity when initiated. Alternatively, the same skill of observing current distress may increase or decrease physiological responses during recovery from a stressful experience. The attitudes of non-judgment and acceptance, may influence physiological reactivity and recovery in both directions (increase or decrease). As fore mentioned, while evidence supports the view that meditation involves active, arousal-promoting processes as well as relaxing processes, empirical studies have not deconstructed this concept through the use of laboratory research.

In addition, research would benefit from comparing, at the physiological level, mindful ways of responding to cognitive-behavioral reappraisal methods. These studies should be conducted comparing the responses during stress and when dealing with diverse emotional and cognitive experiences (e.g. anxiety, anger, and sadness). Several studies need to be devoted to this comparison so that various physiological dependent measures may be explored (e.g. sympathetic markers such as cortisol, impedance, and cardiac output; parasympathetic markers including HRV and oxytocin; and neurological blood flow fMRI mapping). Researchers should measure these variables using diverse experimental manipulations, with diverse clinical populations, and most importantly physiological data should be gathered to reflect both reactivity and recovery from psychological and/or physiological stress.

The Present Research

The current study is a step in the direction of systemic comparison between mindfulness and cognitive modification as a way of coping with stress. Consistent with the previously identified gaps in the literature, the present study examined how mindful ways of responding versus cognitive reappraisal influence RSA during stress and recovery. Given the multifaceted nature of mindfulness, the mindful-coping conditions were split into an acceptance condition and an observe/describe condition. Thus the independent variable was intervention type, which had three levels, including observe/describe, acceptance, and reappraisal. The observe condition asked participants to write their emotions, sensations, and thoughts that were present and to simply label them. The acceptance condition asked participants to allow whatever thoughts, emotions, and sensations to be present and to respond them in a nonjudgmental manner. Finally, the cognitive reappraisal condition asked participants to frame their thoughts in new, alternative ways.

As dependent measures, blood pressure, heart rate, and RSA were collected so that autonomic arousal could be reported as well. Participants were hooked up to an EKG and baseline data was gathered, next they were instructed to recall and vividly remember a sad event from their past, then they were instructed to cope with their thoughts and emotions in a specific way depending on which condition they were assigned to (observe/describe, acceptance/ non-judgment, or reappraisal), and then participants were given a recovery period to relax (See Figure 1 in Appendix A). Following the recovery period, participants were given a measure of depression, anxiety, and stress. Before the experiment was conducted, baseline data concerning health-related variables (e.g. physical activity, prescription drug use, pre-existing medical and psychological conditions, sleep, etc. were collected).

Hypotheses

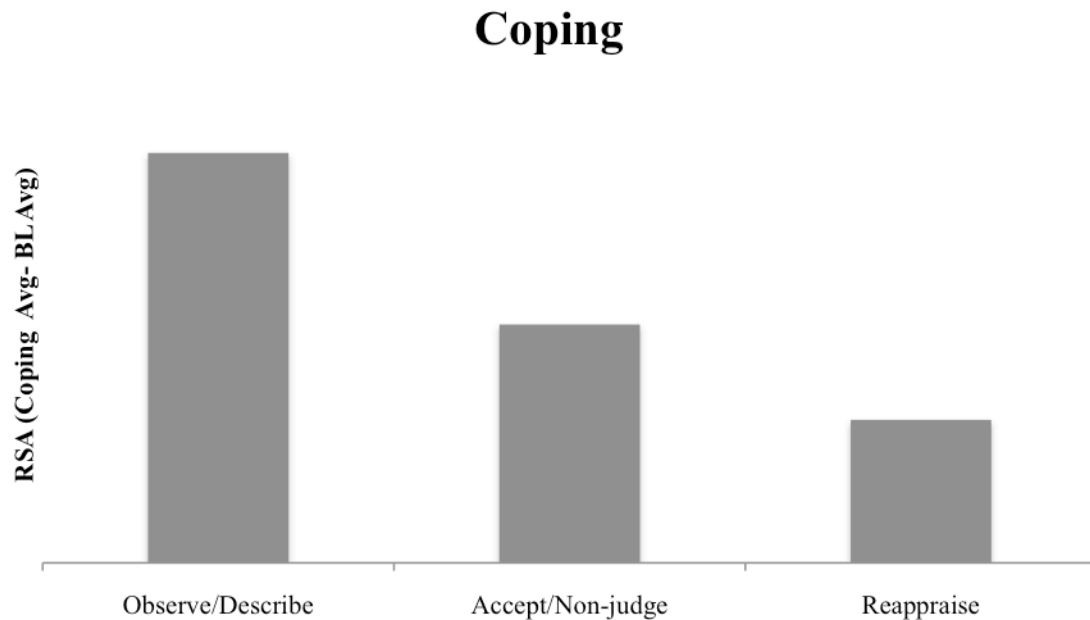
Based on the reviewed literature, it was hypothesized that both mindfulness conditions and the reappraisal condition would show increased RSA levels during the experimental coping inductions compared to during the sad mood induction.

Primary Predictions

Consistent with the literature that defines higher RSA values as an indication of adaptive emotion regulation, hypotheses generated reflect differences in RSA depending on the coping condition the participant was assigned to. The expectation was that once the different coping technique is administered, differences between conditions would be observed during the 10-minute coping procedure as well as during the 10-minute recovery phase.

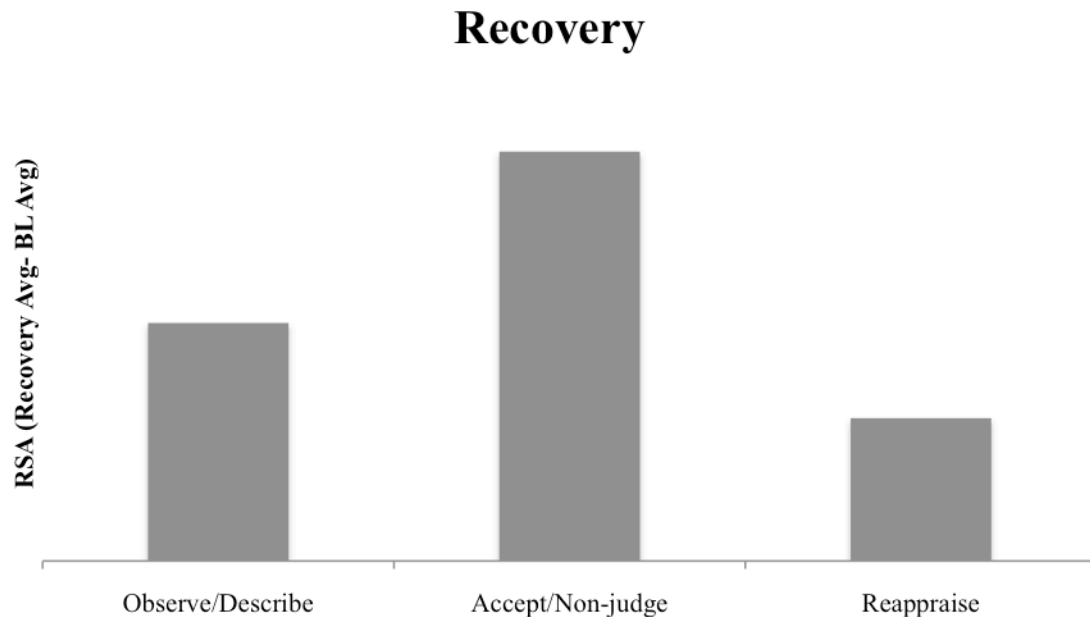
Hypothesis 1: Both mindfulness conditions will display higher levels of RSA in comparison to the reappraisal condition during the coping phase of the experiment. In particular,

it is expected that the observe/describe condition will show a more immediate effect and therefore will result in higher levels of RSA in comparison to the acceptance/non-judgment condition.



Hypothesis 2: Both mindfulness conditions will display higher levels of RSA in comparison to the reappraisal condition during the **recovery** phase of the experiment. Higher sustained levels of RSA may be interpreted as continued superior coping and emotion regulation during recovery for both mindfulness conditions. However, during the recovery phase, it is expected that the observe/describe condition RSA values will decrease, as the accept/non-judge condition's RSA levels will increase. The global prediction for the difference between the observe/describe condition and the acceptance/non-judgment condition is that the effects of the former are more immediate and drop off over time while that later condition shows a more gradual, beneficial response. Therefore, these theoretical differences are reflected via higher

RSA values during recovery for acceptance and non-judgment, the hypothesized more superior approach.



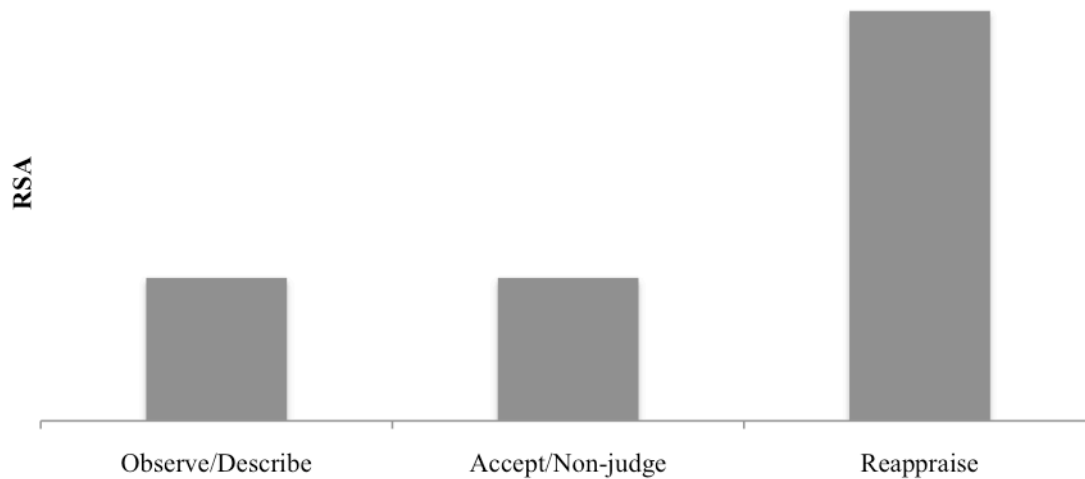
Alternative Predictions

Given that there is a current debate in the literature concerning how to interpret RSA, alternative predictions are warranted. RSA is also influenced via executive functioning demands (e.g. information updating and monitoring, inhibition of habitual response patterns, and mental task-switching). In addition, Segerstrom & Nes (2007) found that tasks that require more self-regulation and effort increase RSA. Therefore, higher levels of RSA may be interpreted as an indication that the participant is currently stressed and is attempting to regulate their stress levels via emotion regulation. Applying these theoretical and experimental accounts into the current study, we would expect that reappraisal condition to show heightened RSA in comparison to the

mindfulness conditions—due to the greater self-regulation involved in the experimental manipulation.

Alternative Hypotheses: The reappraisal condition will display higher levels of RSA in comparison to both mindfulness conditions during the coping phase as well as residual heightened RSA during recovery. Higher levels of RSA for the alternative prediction are a reflection of increased challenge and effort required and since reappraisal is hypothesized to require more effort, heightened RSA is expected for both coping and recovery for the reappraisal condition.

Coping & Recovery

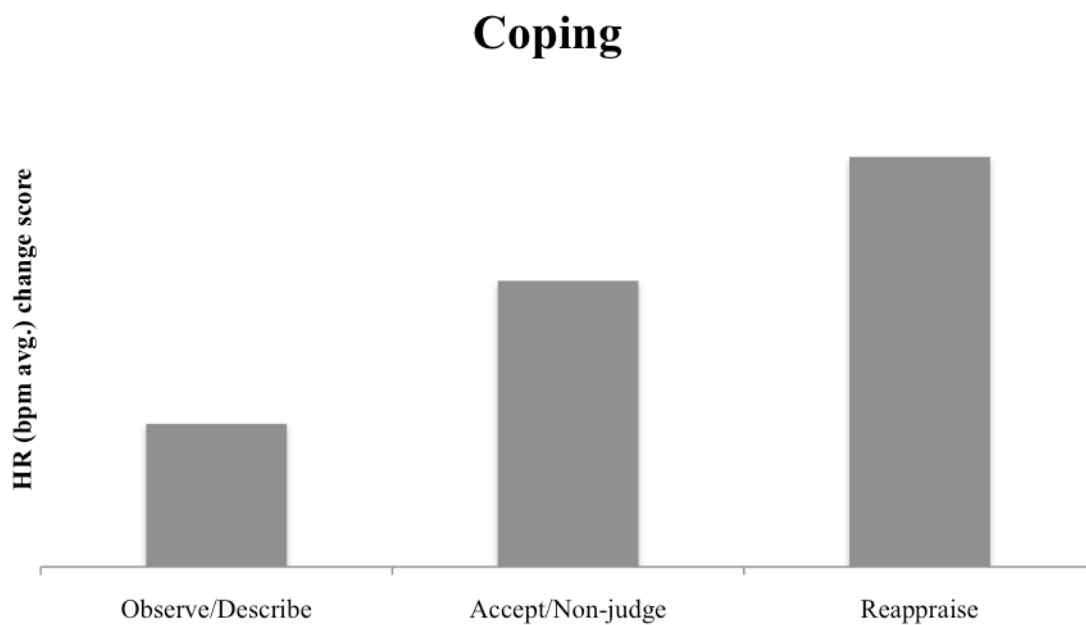


Supplementary Physiological Measures Hypotheses

Heart Rate: Prior research indicates that mindful-acceptance results in decreased stress reactivity (indicated by decreased HR) and evaluative coping results in increased HR (Low, Stanton, & Bower, 2008). However, meditation training has been shown to increase sympathetic

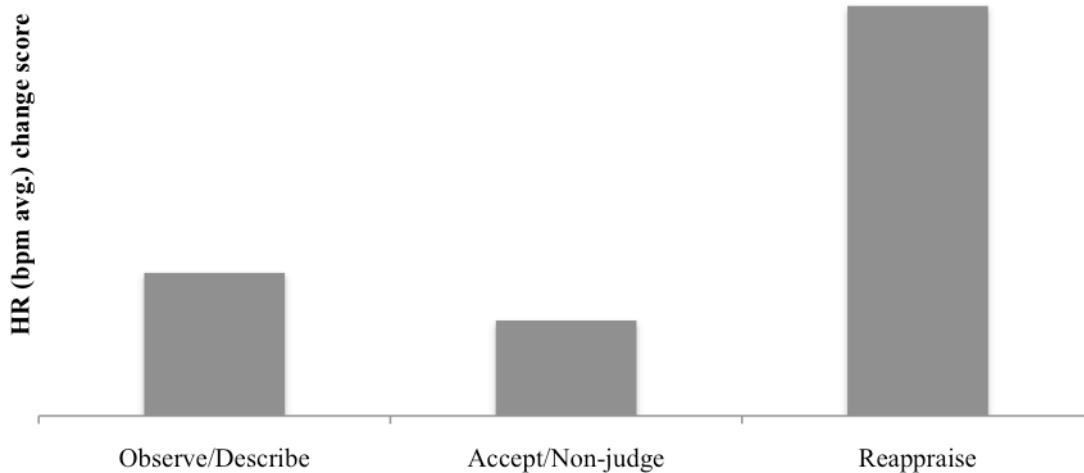
functioning as measured via PEP (Ditto et al., 2006), and authors concluded that this was due in part to the arousing effects of processing challenging thoughts and emotions.

Heart Rate Hypothesis 1: Given the mentioned experimental findings, it is expected that the reappraisal condition will result in the greatest HR during the coping phase. Between the two mindfulness conditions, it is expected that the acceptance/non-judgment condition will display higher HR reactivity during the coping section in comparison to the describe/observe condition. This is due to the fact that the acceptance condition promotes more emotion-related processing and openness to distressing thoughts/emotions.



Heart Rate Hypothesis 2: During recovery, it is predicted that the reappraisal condition will exhibit sustained higher HR in comparison to both mindfulness conditions. Between the two mindfulness conditions, it is expected that the observe/describe condition will sustain the same HR while the acceptance/non-judgment condition will decrease in HR.

Recovery

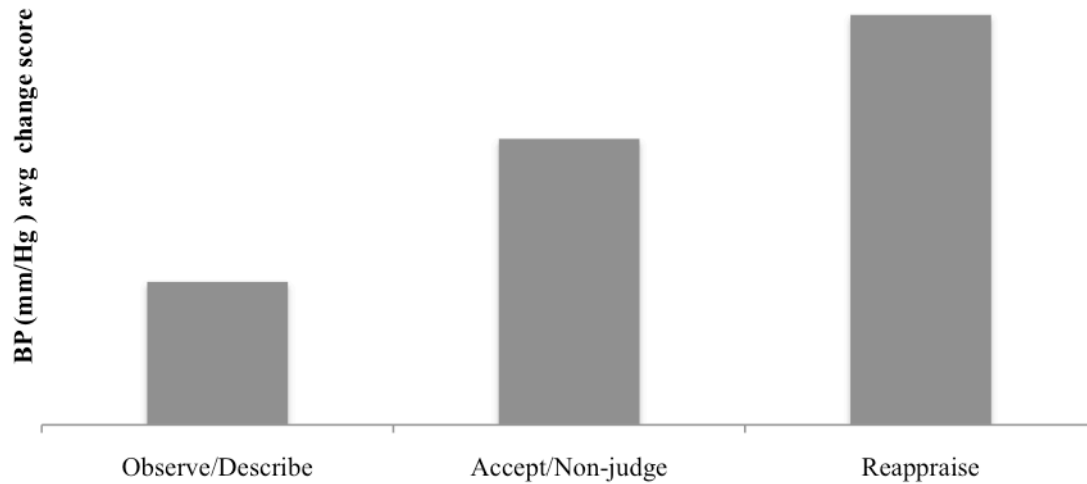


Blood Pressure (BP)

Prior research indicates that mindfulness-based meditation results in decreases in BP (e.g. Carlson et al., 2007; Ditto et al., 2006; Rosenzweig et al., 2007), but all but one of the cited studies examined BP after completion of a mindfulness program. Additionally, as mentioned previously, reappraisal is associated with increased BP (Murray et al., 1989).

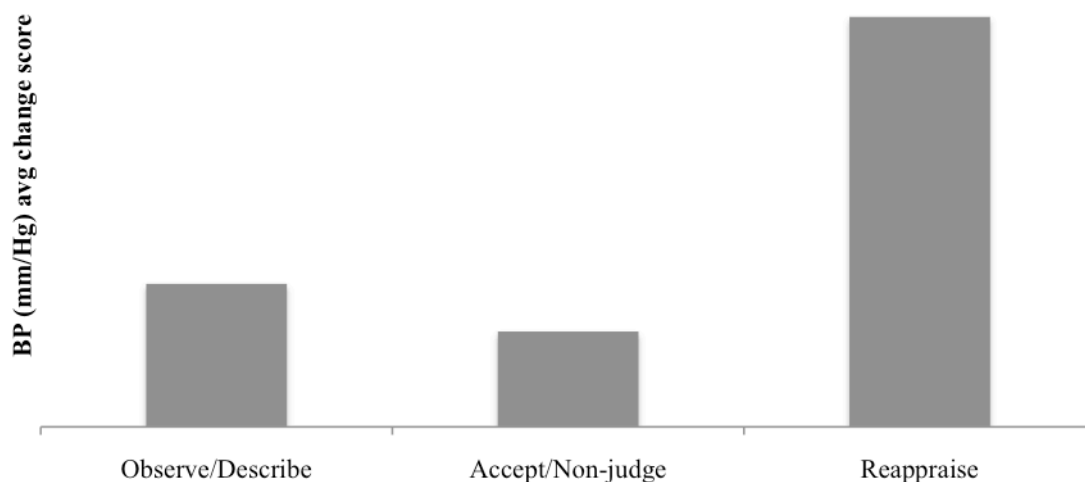
Blood Pressure Hypothesis 1: It is expected that the reappraisal condition will display higher levels of both diastolic and systolic blood pressure during the coping phase, while both mindfulness conditions will display lower BP levels. Between the two mindfulness conditions, it is expected that the acceptance/non-judgment condition will display higher BP reactivity during coping in comparison to the observe/describe condition.

Coping



Blood Pressure Hypothesis 2: During recovery, it is predicted that the reappraisal condition will exhibit sustained higher BP in comparison to both mindfulness conditions. Between the two mindfulness conditions, it is expected that the observe/describe condition will sustain the same BP while the acceptance/non-judgment condition will decrease in BP.

Recovery



Specifically, given that mindfulness acceptance encourages experiential awareness of and openness towards emotions and therefore participants will likely show more pronounced experiential processing of emotions (Carmody, Baer, Lykins, & Olendzki, 2009), it is predicted that the acceptance condition will exhibit lower levels of RSA in comparison to the observe and reappraise conditions during the experimental induction. However, given the previous found effects of superior heart rate recovery and habituation for acceptance and observation coping strategies (Low, et al., 2008), it is predicted that the two mindfulness conditions will display heightened RSA levels during recovery in comparison to the reappraisal condition.

Heart rate and blood pressure data should reflect similar theoretical accounts. Therefore, it is predicted that the two mindfulness conditions will exhibit increased heart rate during the coping procedures in comparison to the reappraisal condition, yet improved recovery marked by decreased heart rate and blood pressure.

Method

Participants

Eighty-four college students were recruited through the University of Kansas psychology department's online recruitment system. Participants were randomized into three separate conditions (A = 27, B = 31, and C = 26). Basic information was provided to potential volunteers on the recruitment website (e.g., time, duration of study, and number of credits towards KU's research participation requirement reimbursed). See Table 1 for a complete summary of sample characteristics.

Table 1
Sample Characteristics

Variable	<i>n</i>	%
Sex		
Female	45	50.6
Male	39	46.4
Race		
Caucasian	66	78.6
African American	7	8.3
Asian/Pacific Islander	5	5.6
Hispanic/Latino	4	4.5
Other	2	2.2

Inclusion criteria. Only fluent English speakers will be eligible for participation, as it would be difficult for non-English speakers to accurately complete all questionnaires for this study. Information regarding the presence of a serious health condition, pregnancy, and breast-feeding (see Appendix B for screening form) was collected to their known interactions with heart functioning. No participants were excluded for these reasons. Information related to smoking, alcohol and illicit drug use, and general level of physical activity was also collected as part of the baseline questionnaire packet (18 questions, Appendix B), as these have been associated with

cardiovascular reactivity in previous literature (Goyal, Shimbo, Mostofsky, & Gerin, 2008). Additionally, experimenters measured participants' height and weight due to their known interactions with heart functioning. Per condition average BMI levels did not vary between groups (Condition A = 23.72, Condition B = 22.45, and Condition C = 24.34), and therefore BMI information was not used as a control variable. In addition, if a participant's blood pressure average over the three consecutive readings is higher than 143mmHg/94mmHg, the participant was excused from the study and was given credit for the time they were present. We provided them with contact information for the campus health center and gave them basic information on blood pressure from the American Heart Association as well as feedback on what their blood pressure was (see Appendix C). A total of two participants were excluded from the study due to high blood pressure.

Measures

Depression and Anxiety. Depression Anxiety Stress Scales (DASS; Crawford & Henry, 2003; Lovibond & Lovibond, 1995) The DASS includes 42 items measuring negative affect and bodily symptoms that applied to them over the past week. Responses range from 0 to 3, with 0 indicating that the item did not apply to the participant and 3 indicating that the item very much or most of the time applied to the participant. Total scores are calculated for depression, anxiety, and stress.

Experimental Protocol

Prior to the day of the experiment, participants were emailed a reminder email with instructions not to eat, smoke, or drink caffeine within 90 minutes of coming to participate. They were also asked not to exercise the day of participation. Before the participants are connected to

the electrodes, questions regarding physical status were administered and the background screening information discussed in the inclusion criteria section was administered.

Once the screening measure was collected to ensure that the participants were healthy enough to continue with the study (see Appendix B), participants were hooked up to a blood pressure cuff for baseline readings to ensure that their blood pressure was in accordance with the American Medical Association's guidelines (see Appendix C). Following clearance on blood pressure readings, the participants were connected to the EKG electrodes in a Lead-II configuration using a 7-electrode arrangement and Mindware Analysis Software 6.1 was used to record and monitor the EKG signals (Mindware Cardiography system, Gahanna, OH) so that HRV could be measured.

Participants underwent a baseline period, during which they rested for 10 minutes while blood pressure and EKG signals were collected. Following the baseline period, all participants were given specific instructions via a computer to recall an event that they could remember vividly that still makes them sad to think about. Examples were given such as the death of a young brother in a motorcycle accident and a romantic relationship that ended. Participants were instructed to focus on the memory and write a few sentences and really intensely get into the feelings of the memory (See Appendix D). This form of inducing sad emotions is a variant of the Velten Sad Mood Induction (Kenealy, 1986; Velten, 1968; Westermann, Spies, Stahl, & Hesse, 1996) in that an autobiographical component is added, which has shown to be more effective in helping participants get into a sad mood state (Hernandez, Vander Wal, & Spring, 2003). This technique is a validated technique that has been used in conjunction with physiological parameters and has been shown to influence physiological functioning (e.g. Terhaar, et al., 2010). The addition of asking participants to close their eyes and concentrate on the sad feeling

and let it grow stronger as they think about things in their life that make them feel depressed and down has been demonstrated to enhance the effects of the standard mood induction procedures (Zoellner, Sacks, & Foa, 2003).

To ensure that all participants selected a sad event to recall, all responses were linguistically checked to ensure that the instructions were followed. Two research assistants, blind to the conditions each participant was assigned to, were given a file with the all of the participants' written responses. The research assistants were trained to recognize what the conditions were and were given examples of each experimental condition, and then were asked to generate a list with participant ID and their best guess as to what condition the participant was in. The inter-rater reliability between coders was high ($\kappa = .883$ (95% CI), $p = .00$). Only one participant was thrown out due to non-compliance to condition instructions. It was important for this study not to gather mood data between the two experimental tasks so that the mood questionnaire would not influence the next set of instructions.

After the 10 minute sad mood induction, participants were assigned to one of three conditions to cope with the evoked emotions for an additional 10 minutes: (1) Observing and Describing; (2) Accepting and Non-judging; (3) Reappraisal. Additionally, given RSA is highly influenced by the level of self-regulation required, it was important in writing the coping instructions that they require about the same amount of cognitive load and so they were created to be around the same reading level 3rd-4th grade and similar in format and length (Segerstrom & Nes, 2007). Instructions for each condition are in Appendix D.

Finally, there was a 10-minute recovery period in which the participants were instructed to relax. Physiological data was gathered throughout the 40-minute period of baseline, sad-

emotion event recall, experimental manipulation in which participants were assigned to one of the three conditions, and recovery. Blood pressure data was collected every three minutes to ensure that we could balance collecting enough data to capture changes in functioning while at the same time allowing sufficient time for the participant to relax between measurements. After the recovery period, the electrodes were detached and depression and anxiety data was collected via the same computer. Participants were debriefed, thanked for their time, and given information regards to seeking therapy and consultation through the Psychological Clinic.

Heart Rate Variability Data Reduction

To derive RSA, the raw ECG data were first inspected using automated software and then visually inspected according to the guidelines for detecting artifacts and abnormal beats (Berntson, Quigley, Jang, & Boysen, 1990). HRV Analysis Software 6.1 (Mindware Cardiography system, Gahanna, OH) was used to verify, edit, and summarize cardiovascular data. For each participant, ECG data were ensemble averaged for each minute. The same HRV analysis software was used to derive heart rate variability (ms^2/Hz) by applying spectral analysis to the interbeat interval series (IBI series-the time between successive R-peaks) from the ECG. The IBI series was time sampled at (4 Hz) to produce an equal time series. The equal series was then detrended, end tapered, and submitted to a fast Fourier Transformation according to procedures outlined by (G.G. Berntson, et al., 1997). Spectral analysis was used to decompose heart rate variability at specific frequency components. The frequency component of RSA is the parasympathetic-derived portion that corresponded to the high frequency (HF) portion of the respiration cycle (0.15-0.40 Hz). A total of seven participants were thrown out due to difficulties with the collection of the data (two from condition A, three from condition B, and two from condition C).

Psycho-physiological Data Reduction and Analytic Procedure

Average levels of RSA were calculated for baseline, coping, and recovery by averaging the values over the 10 minute time periods. Then change scores were computed for the primary dependent variables by subtracting the average baseline value from the period of interest. For the central hypotheses, these include changes in RSA reactivity (mean RSA during sad mood induction minus mean RSA during baseline), RSA during coping (mean RSA during experimental manipulation minus mean RSA during baseline), and RSA recovery (mean RSA during recovery minus mean RSA during baseline (Glynn, Christenfeld, & Gerin, 2002; Steptoe & Marmot, 2006). Similar change scores were calculated for diastolic and systolic blood pressures and heart rate (HR). Raw change scores were used rather than residualized change scores, as recommended by (Llabre, Spitzer, Saab, Ironson, & Schneiderman, 1991).

In order to assess whether participants showed expected changes depending upon condition assignment for RSA, systolic blood pressure, diastolic blood pressure, and heart rate, univariate ANCOVAs were conducted to compare differences between groups at the two time-points of interest (coping and recovery). Change scores were calculated by subtracting participant baseline data from the time-point of interest. Given all participants engaged in the same stress task, hypotheses and results in regard to the stress tasks were not of interest. However, an ANCOVA was conducted to ensure that there were not significant differences between groups. There were not significant differences between groups during the stress task ($F = .142$, $p = .868$). Throughout the results section, letters are used to represent experimental conditions (A = Observe/Describe, B = Acceptance/Non-judgment, C = Reappraise) and means are reported in parentheses.

Preliminary Analyses

T-tests were performed to compare differences between groups for sex, age, self-reported health behaviors (smoking, alcohol, drug/prescription use), physical activity, and BMI. The only significant findings that arose were differences between conditions A & B for anxiety ($F = 7.92$, $p = .007$) and stress ($F = 10.33$, $p = .002$) levels (see Table 2). Given these findings, all analyses controlled for anxiety and stress levels. In addition, all raw data per condition for all of the dependent variables may be found in Appendix D, Table 1.

Table 2

Psychological controls means and standard deviation in parenthesis per condition with corresponding significant group differences indicated.

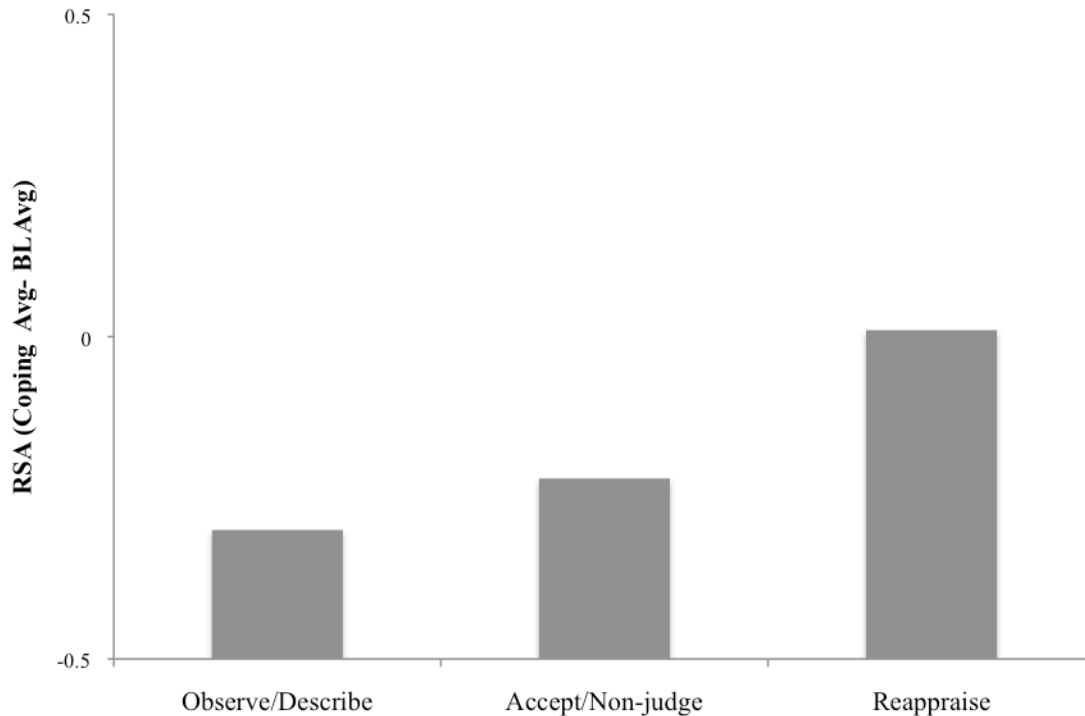
	A (Observe)	B (Accept)	C (Change)
Depression	2.96 (4.13)	3.83 (3.11)	4.12 (4.50)
Anxiety	2.96 (3.02)	6.9 (5.11)	4.96 (4.95)
Stress	5.89 (4.92)	11.07 (8.37)	8.50 (7.51)

Results

Coping

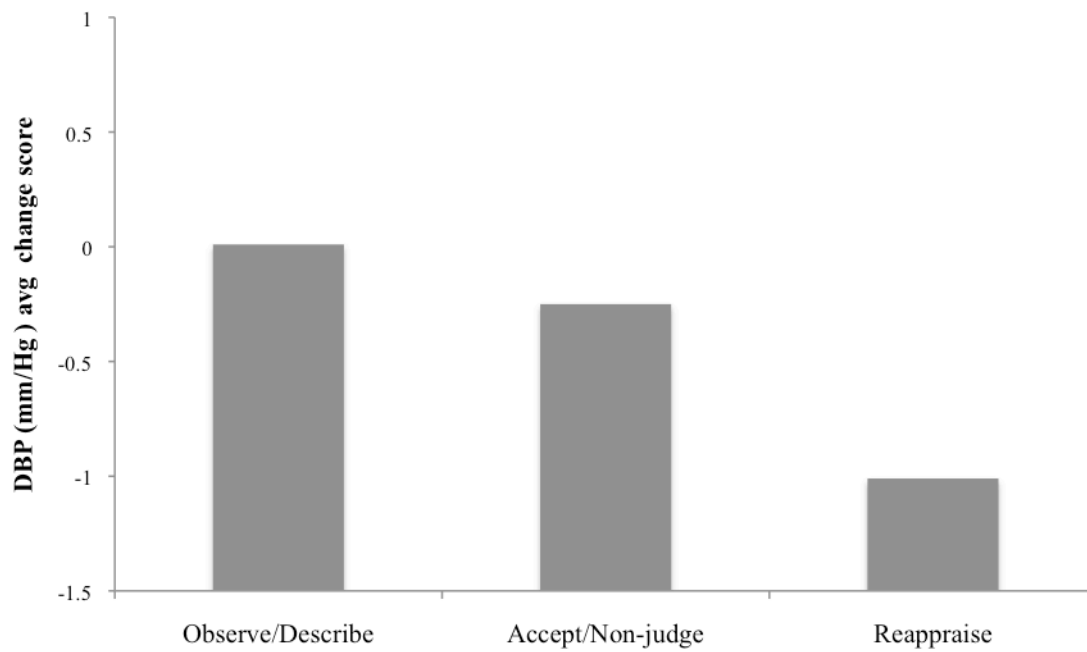
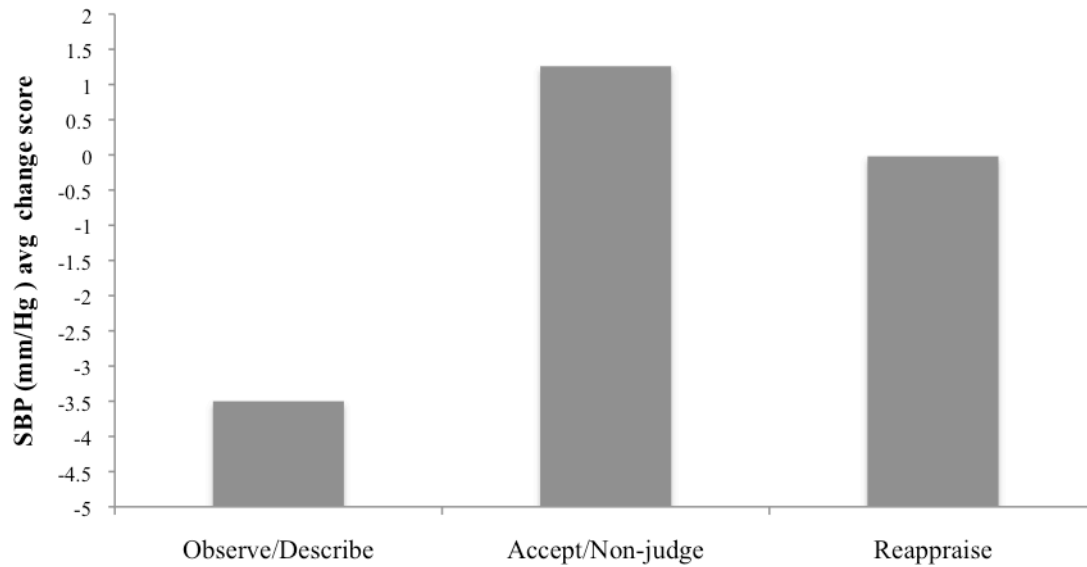
RSA. Data was consistent with the alternative hypothesis, in which higher levels of RSA for the alternative hypothesis are a reflection of increased challenge and effort required. Therefore, since reappraisal was hypothesized to require more effort, heightened RSA was expected for the reappraisal condition compared to both mindfulness conditions during coping. Both mindfulness conditions ($A = -.30$, $B = -.22$), displayed numerically lower levels of RSA during the coping

phase of the experiment in comparison to the reappraisal condition ($C = .01$). This effect was not statistically significant ($F = 0.72$, $p = .49$). Data did not support the primary hypothesis that both mindfulness conditions would display higher levels of RSA in comparison to the reappraisal condition.

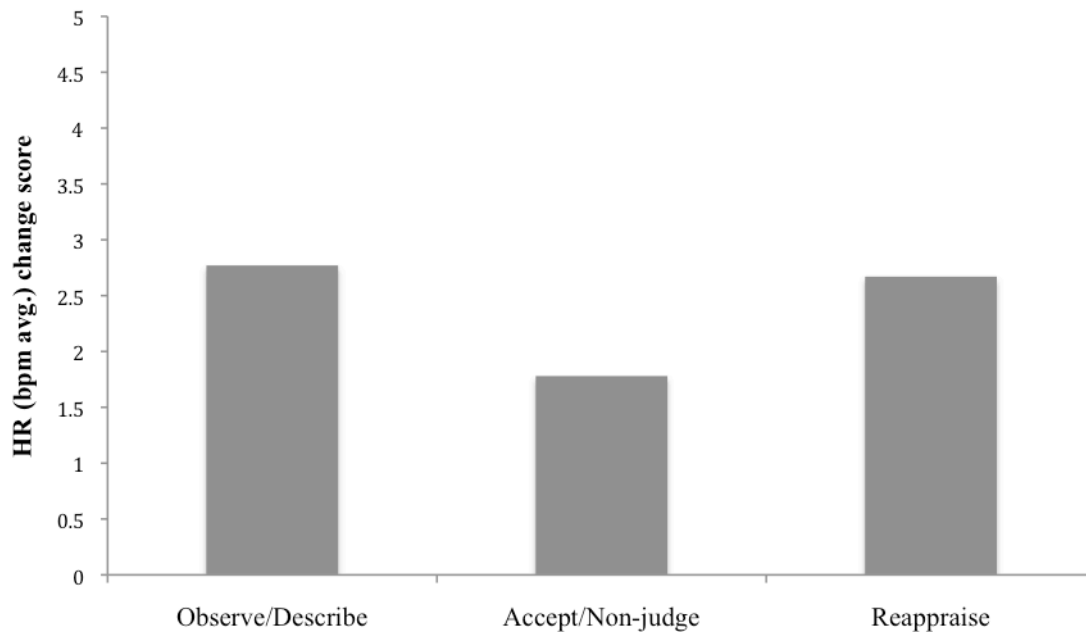


Blood Pressure. For systolic blood pressure, the following mean change scores were observed between conditions ($A = -3.50$, $B = 1.26$, $C = -.02$). There was a significant difference observed between conditions in which the observe/describe condition displayed lower values compared to both the accept/non-judge condition and the reappraise condition, which is consistent with the hypothesis that the mindfulness conditions would display lower blood pressure during the coping phase. However, the finding that the reappraisal condition displayed lower blood pressure in comparison to the accept/non-judge condition is not consistent with the hypothesis, ($F = 3.64$, p

= .03, ($\eta_p^2 = .10$). There were no significant differences between conditions for diastolic blood pressure (A = .01, B = -.25, C = -1.01), $F = .40$, $p = .67$.

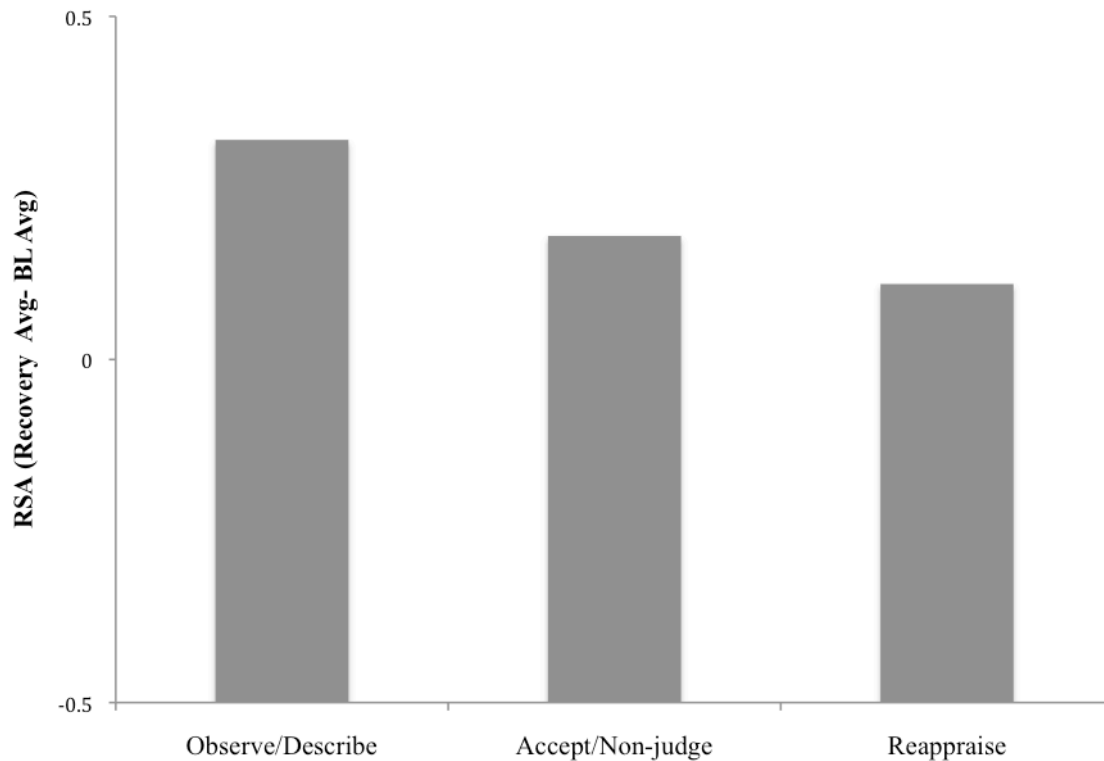


Heart Rate. The hypothesis for heart rate was that the reappraisal condition would have higher levels of heart rate compared to both mindfulness conditions, and in particular the acceptance-non-judge condition would display higher heart rate compared to the observe/describe condition. This hypothesis was not supported. There were no significant difference between conditions regarding heart rate changes ($A = 2.77$, $B = 1.78$, $C = 2.67$), $F = .55$, $p = .58$.

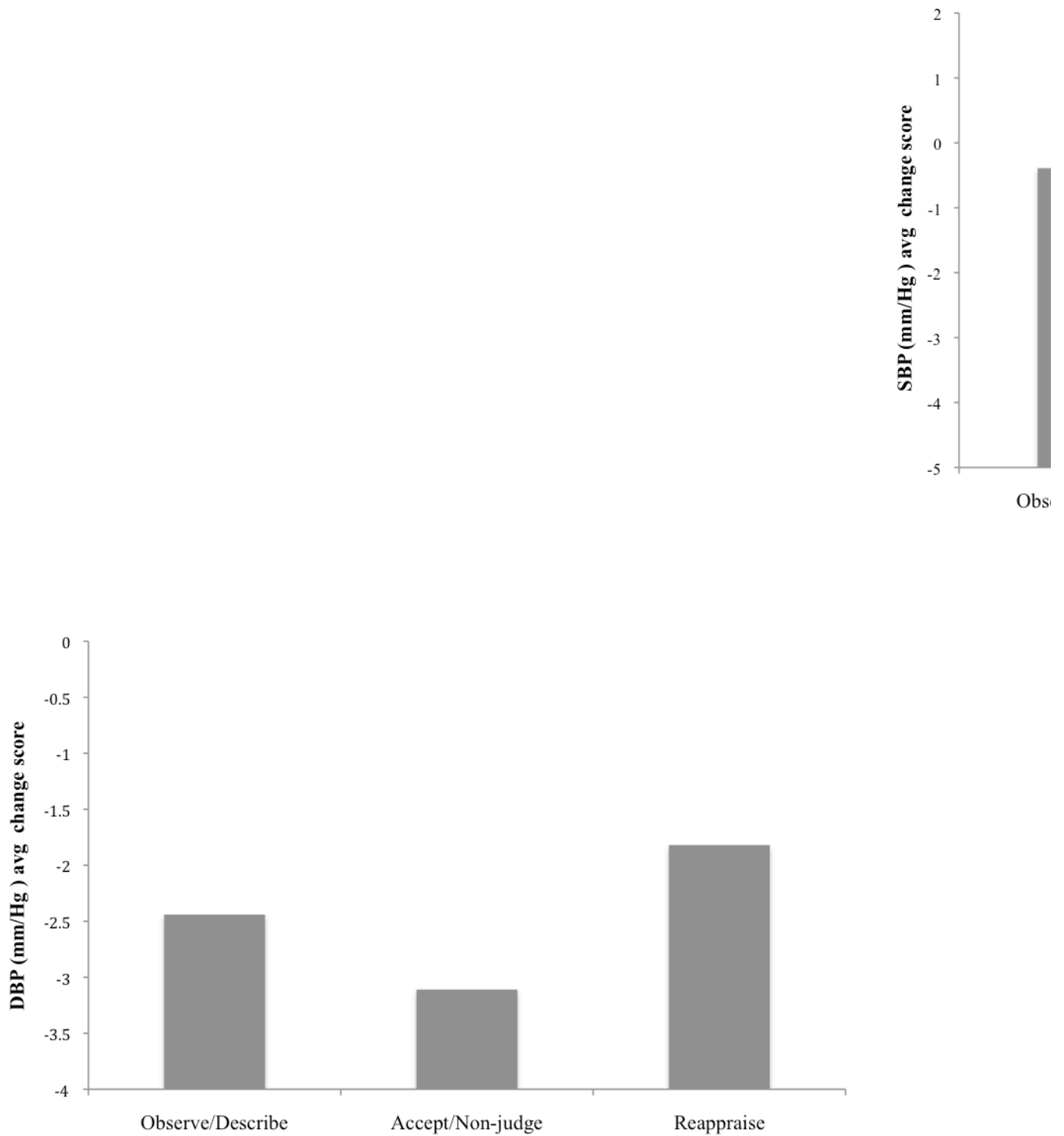


Recovery

RSA: Consistent with the hypothesis that higher levels of RSA represent superior physiological coping, both mindfulness conditions ($A = .32$, $B = .18$) displayed heightened RSA in comparison to the reappraisal condition ($C = .11$) during recovery. This effect was not statistically significant ($F = .08$, $p = .93$).

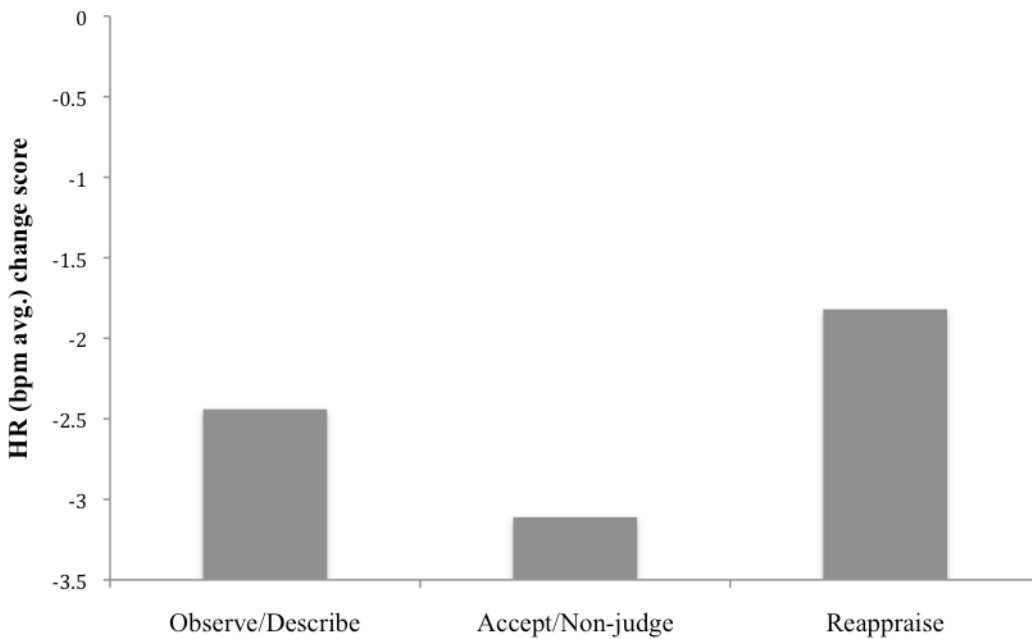


Blood Pressure. The hypothesis for recovery was that the reappraisal condition would exhibit higher levels in comparison to both mindfulness conditions. However, this hypothesis was not supported for either systolic or diastolic blood pressure. There were no significant differences between conditions for systolic blood pressure ($A = -.39$, $B = .82$, $C = -1.22$, $F = .63$, $p = .54$). There were also no significant differences between conditions for diastolic blood pressure ($A = .44$, $B = .73$, $C = -.33$), $F = .76$, $p = .47$).



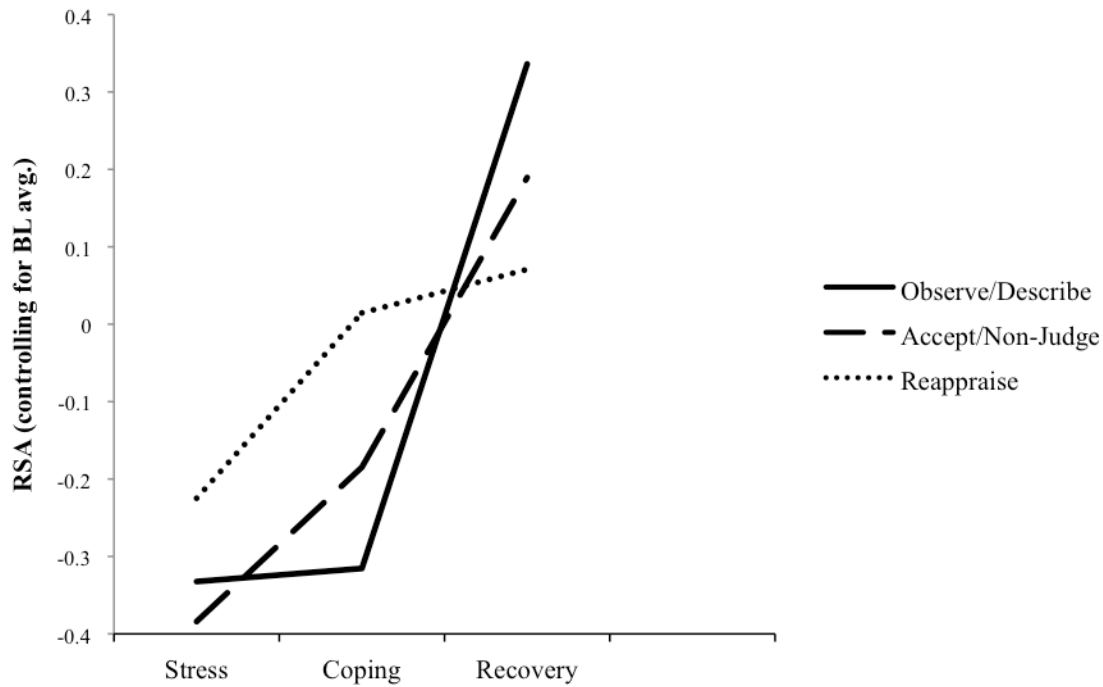
Heart Rate. The hypothesis for heart rate recovery was that the reappraisal condition would exhibit higher levels compared to both mindfulness conditions, and in particular that the

acceptance condition would display the lowest levels. This hypothesis was not supported. There were no significant difference between conditions regarding heart rate changes ($A = -2.44$, $B = -3.11$, $C = -1.82$), $F = .50$, $p = .61$). Although the trend suggests that both mindfulness conditions had decreased heart rate during recovery in comparison to the reappraisal condition.

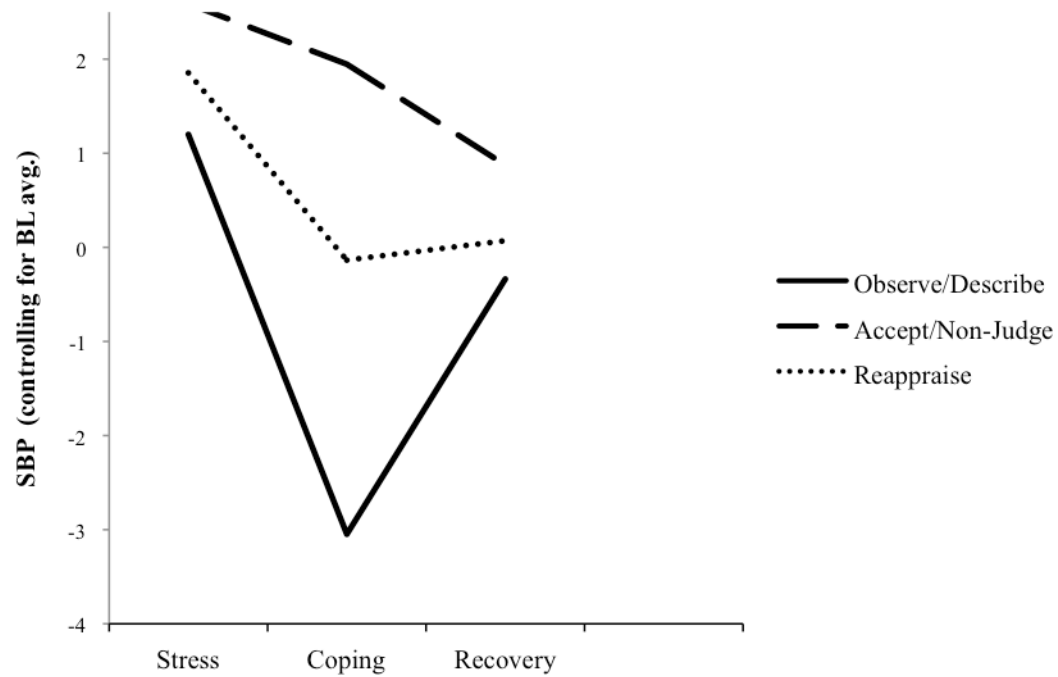


Interpreting Null Findings & Post-hoc Analysis

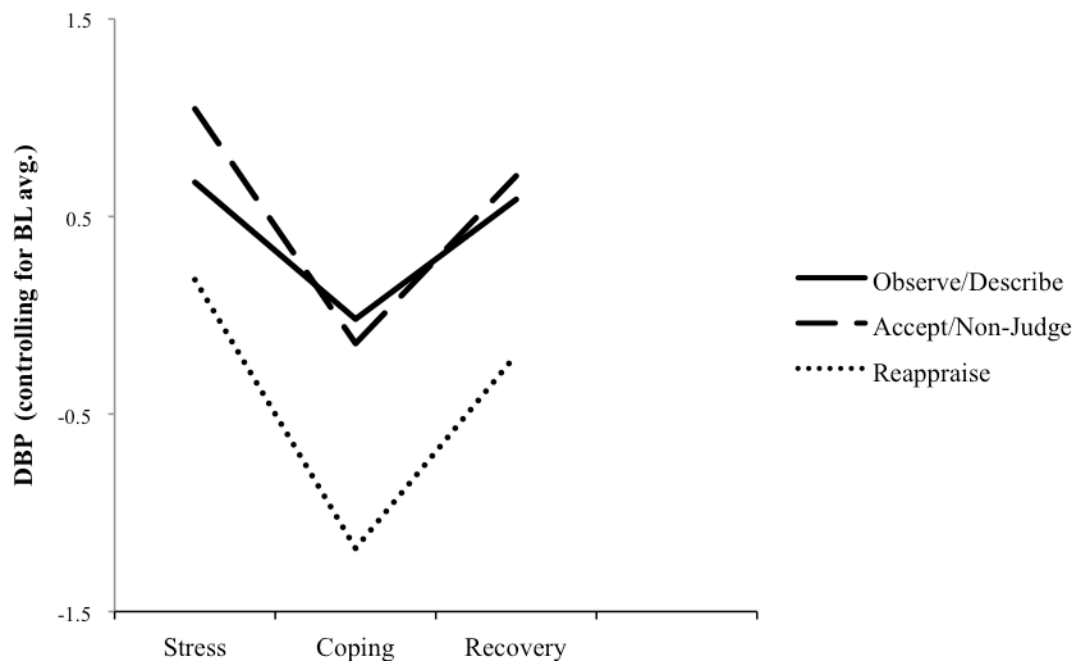
Given the non-significant findings, it is essential to clarify why we did not find the expected differences between the conditions of interest. A post-hoc analysis examining the changes across the time of the experiment was used to ensure that changes did occur between the study time points (stress, coping, and recovery) for RSA (see Appendix E Table 2 for a summary of these analyses). The repeated measures analysis of variance results confirm that there was a significant time effect ($F = 16.61$, $p = .00$), in which each condition showed expected physiological variability from stress to recovery (see graph below).



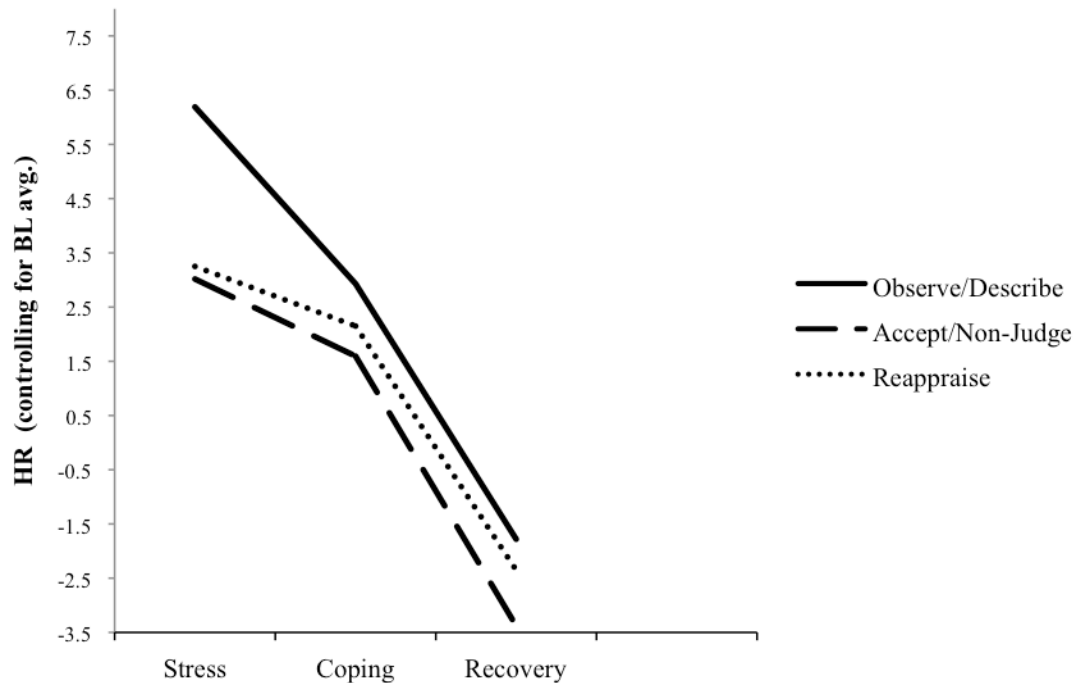
In addition, all other supplementary measures showed statistically significant effects for change across time of the experiment in the direction that supports coping with stress in a positive manner. The supplementary measures did not show statistically significant differences between groups either. Systolic blood pressure data displayed changes across time and the repeated measures analysis of variance was significant ($F = 6.98, p = .00$), shown below.



Diastolic blood pressure effects also showed significant changes across time and the repeated measures analysis of variance was significant ($F = 3.06$, $p = .05$), shown below.



The final supplementary measure, heart rate, also displayed significant changes across time and the repeated measures analysis of variance was significant ($F = 67.58, p = .00$), shown below.



Given the significant time-effect findings, this suggests that the manipulations did in fact succeed in influencing physiological parameters. If there was not a significant time effect and there was not variability between conditions, the data would have suggested that the manipulations did not work in altering physiological reactivity. However, the differences between conditions were not strong enough to generate statistical significance. The physiological outcomes of this study lead to the conclusion that all of the interventions were essentially worked similarly in influencing physiological functioning.

Discussion

The purpose of this study was to partial out the physiological effects of mindfulness-based versus change-based processes in the context of dealing with difficult emotions, thoughts, and sensations. The hypotheses were that the two mindfulness conditions (acceptance/non-judgment and observe/describe) would display more adaptive physiological responses during both coping and recovery phases of the experiment in comparison to the reappraisal condition. In particular, it was predicted that the mindfulness conditions would show increased RSA and decreased heart rate and blood pressure readings in comparison to the cognitive-reappraisal condition.

The primary outcome measure of interest for this study was RSA, a measure of HF HRV. This outcome measure is an index of PNS activation. Furthermore, PNS activation usually requires mental effort and is often a matter of resisting the temptation to respond automatically to challenging situations, emotions, thoughts, and body sensations (Segerstrom & Nes, 2007). An increase in PNS functioning, as indexed via heightened RSA, reduces energy demands in the periphery and promotes calm reflection (Fairclough & Houston, 2004; Porges, 2001). Additional measures, including both diastolic and systolic blood pressure and heart rate were also collected given the novelty of measuring HF HRV and the need for additional data to make a well-informed comparison across conditions.

As mentioned in the literature review, increased RSA has been linked to executive functioning (Segerstrom & Nes, 2007). Reappraisal is a form of coping that involves executive functioning—such as information updating and monitoring, inhibition of habitual response patterns, and mental task switching (Miyake, Friedman, Emerson, Witzki, & Howerter, 2000).

Therefore, it was suspected that the use of reappraisal to cope with a sad-life event in this study would aid in increasing RSA. However, only a few studies have reported on the use of reappraisal versus other coping strategies with RSA or HF HRV as a dependent variable. Of the studies reviewed in the introduction, one found that reappraisal increased RSA values in comparison to control and suppression conditions (Denson, Grisham, & Moulds, 2011). However, the other study found no difference between reappraisal and suppression conditions (Butler, Wilhelm, & Gross, 2006).

Physiological functioning in the context of coping with stress has been explored more thoroughly in the context of using mindfulness-meditation based techniques. Different forms of mindfulness strategies have shown increases in RSA and HF HRV (Ditto, Eclache, & Goldman, 2006; Vest Rogers, 2009). However, there has been a lack of empirical research examining the effects of trait mindfulness on laboratory stressors. Instead, most of the research has examined how meditation practice improves RSA. The reluctance to study mindfulness in this way is more than likely due to the challenges in trying to teach meditation to participants who have never tried it before. A way to get around this feat is to separate out mindfulness into its components, which in the long run is likely more beneficial so that we can better understand the active ingredients of mindfulness as a coping mechanism. For example, Low, Stanton, & Bower (2008) found that the practice of accepting one's emotional response without taking active attempts to evaluate the appropriateness of one's response resulted in decreased HR. In addition, the mindfulness skill of observing thoughts and emotions without becoming entangled in them has been isolated apart from the mindfulness skill of acceptance. Mindful observation has been associated with increased frontal cortex activity and self-regulation (Creswell, Way, Eisenberger, and Lieberman, 2007). Finally, trait mindfulness has been associated with decreased cortisol in

response to lab stress tasks (Brown, Weinstein, & Creswell, 2012). Given there have been several more studies and more consistent ameliorative effects examining HF HRV and mindfulness compared to reappraisal techniques, the hypotheses were in favor of mindfulness strategies.

As a summary from the background physiological information, this study was designed to fill several gaps in the current literature—the study highlighted the use of mindfulness as a coping style and not simply as a meditation technique, it separated mindfulness into two of its known forms of beneficial coping (acceptance/non-judgment and observation), it compared mindfulness to reappraisal coping, it separated the experiment into important time segments for data analysis (stress, coping, recovery paradigm), it was one of only a handful of studies to examine cognitive reappraisal and RSA, and it used several physiological outcome variables to paint a more complete picture.

Interpreting Results

Overall, results support the conclusion that there is no difference physiologically between mindfulness-based coping strategies in comparison to reappraisal for this study. As mentioned, the post-hoc analyses revealed that there were significant time-effects for all four of the physiological measurements, meaning that the manipulations did significantly alter physiological activity. Specifically, measures of RSA increased throughout the time course from stress to recovery, suggesting that all three forms of coping increase physiological self-regulation. Systolic and diastolic blood pressure decreased for all three conditions from stress to coping, signifying that all three coping methods benefited the stress response. Heart rate measures

decreased across time as well. Interestingly, while systolic and diastolic blood pressure increased during recovery, heart rate levels continued to decrease.

The only significant finding comparing group differences that arose was for systolic blood pressure, indicating that the observe/describe condition had lower systolic levels during the coping phase of the experiment in comparison to the accept/non-judge condition and the reappraisal condition. However, given this was the only significant finding, it is not enough to make a conclusion regarding substantial difference between the groups. Therefore, we can conclude that for this study on sad-mood, coping about a past life-event applying mindfulness versus reappraisal coping techniques both provide support in decreasing physiological stress in the short term. There was no control condition and perhaps any effort to cope with stress may be capable of altering physiological reactivity. This control condition effect needs to be tested in future studies. While all three methods tested helped in changing physiological wellbeing in the short term, we are unsure about the long term benefits given this study did not gather delayed data. Additional limitations are discussed below.

Limitations & Future Directions

Although this study did not find significant effects between conditions, it is important to highlight that this is the first study known to manipulate and compare mindfulness coping to reappraisal techniques in response to sad-life events. Past research has been successful in finding statistical significance when comparing mindfulness non-judgment and acceptance coping to an evaluative condition in which participants were asked to judge the appropriateness of their emotional response after recalling a stressful life event (Low, Stanton, & Bower, 2008). Therefore, it may be true that there are not significant differences physiologically between

mindfulness and cognitive-reappraisal techniques. However, future studies need to replicate this finding using diverse methods.

Future studies will benefit from comparing mindfulness-based coping to reappraisal using a population that has been trained more extensively in mindfulness-meditation, to see if there are training effects in being able to apply mindfulness techniques. In the current study, mindfulness was separated into two different conditions, and it may be that mindfulness is most effective when practiced as a complete package in which one can observe and describe ongoing stimuli with an attitude of non-judgment and acceptance. Secondly, different techniques may be superior physiologically depending upon the stress task. For example, experimenters may vary the task type to evoke different physiological and emotional states, such as fear/anxiety, sadness, anger, or stress. While the current study is sophisticated in that the experimental manipulations are simple to check for adherence given the written component, the writing task itself is not a strategy that is typically used by individuals when they are stressed in everyday life. Other tasks may be more realistic, such as simply asking the individual to meditate and report on their emotional state. In addition, while it is beneficial to test mindfulness techniques in a healthy population, given the widespread dissemination of meditation, distressed populations may increase the likelihood of obtaining variability between conditions. Therefore, another alteration would be to manipulate healthy versus control conditions, such as seeking out a depressed, anxious, hypertensive, or chronic illness population.

The current physiological outcome data (RSA, HR, DBP, SBP) may not be sensitive enough to capture fine-tune differences between the conditions. Future research may need to examine real time electrical and functional brain activity utilizing advanced EEG methodology or a hormonal system (e.g. cortisol). Timing and collection of the physiological data may also be

important. For example, much like the findings of Vest Rogers (2009), it may be that mindfulness-forms of coping do not show their effects during the time of the stressor but promote heart-healthy measures during the later part of the day as a result of successful psychological processing. However, the current study added onto what is typically collected, in that it was subdivided into reactivity, coping, and recovery. This technique should be used in subsequent studies so that we can extend our understanding of particular time points during the stress response, rather than obtaining general findings such as average levels of physiological variables throughout the experimental manipulation. Furthermore, reactivity and recovery have been researched and are known to have health-prognostic capabilities, such as predicting future hypertension cardiovascular disease outcomes (Matthews et al., 2004).

Despite limitations of the current work, results may contribute by encouraging increased communication among mindfulness and cognitive-change camps. As there is an increase in both forms of therapeutic interventions and styles in which they may be applied, it is essential to compare physiological beneficial effects. As mentioned previously, mindfulness in particular has been marketed as a health-promoting agent of change, while researchers have not been diligent in comparing their interventions to other known effective ways of managing stress. Researchers should not be quick to make sweeping judgments regarding their effectiveness above and beyond other styles of coping until adequate comparison research has taken place.

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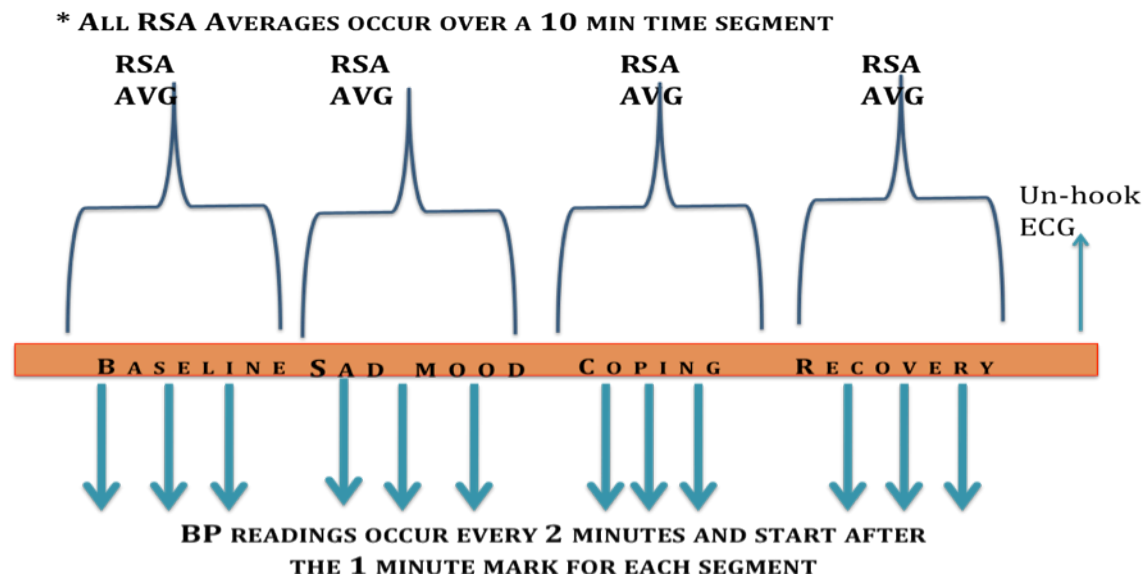
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Appendix A

Figure 1



Appendix B

SCREENING QUESTIONNAIRE: * indicate questions that which will result in exclusion if YES is indicated.

1. Please indicate if you have EVER been diagnosed with or currently have any of the following:

* Asthma(Y/N)

* Hepatitis, Rheumatoid arthritis, Multiple Sclerosis, HIV, or any other autoimmune disease (Y/N) * Thyroid disease, Adrenal Disease or regular steroid use (such as anabolic steroids, prednisone use or corticosteroids) (Y/N)

*A psychological or psychiatric disorder (Y/N) (e.g., depression, schizophrenia, social anxiety disorder)

*Diabetes (Y/N) If Yes, what Type (I/II)

*Chronic sinusitis (Y/N)

*Bronchitis (Y/N)

*Cardiovascular disease (e.g., a heart condition) (Y/N)

*Any other chronic illness (Y/N) (if yes, please specify_____)

*An allergy to tape or adhesive

2. How many alcoholic beverages do you consume in an average week?
(please type Y after the appropriate number of beverages)
0-6 6-12 over 12

3. FOR WOMEN ONLY: Are you currently pregnant or breast feeding? (Y/N) *

4. Please list in the space below ALL medications (both prescribed and over the counter) that you are currently taking (e.g., birth control, antibiotics):

5. Is English your first language? yes no

a. If NO: are you fluent in English and have both fluent understanding & writing ability

YES NO *

Speech that Experimenter will deliver if subject is excluded:

Based on your responses to one or more of these answers, you are unfortunately not eligible to participate in this study. This does not indicate that anything is wrong with you, but only that for the purposes of this specific study, are you not eligible. Thank you VERY much for your time and interest in this study. We will compensate you for the time that you spent here and hope that

this doesn't dissuade you from participating in psychology department research studies in the future.

Demographics:

1. How old are you? _____ years
2. Are you male or female? _____ male _____ female
3. How would you describe your primary racial or ethnic group?

- _____ (1) White, Caucasian
- _____ (2) Black, African-American
- _____ (3) Native American, Eskimo, Aleut
- _____ (4) Asian or Pacific Islander
- _____ (5) Hispanic, Latino
- _____ (6) Other specify _____

4. Do you currently smoke cigarettes, cigars, or a pipe on a daily basis? ____ yes ____ no

[If YES] 4a. On average, how many of each do you smoke per day?

_____ cigarettes _____ cigars _____ bowls of tobacco

- 4b. How soon after you wake up do you usually smoke your first cigarette, cigar, or bowl of tobacco? _____ minutes

If you answered NO to question 4, please answer questions 5 and 6.

5. Did you ever smoke cigarettes, cigars, or a pipe on a daily basis? ____ yes ____ no

[If YES] 5a. When you were smoking your heaviest, how many of each did you smoke on an average day?

_____ cigarettes _____ cigars _____ bowls of tobacco

- 5b. When did you quit smoking on a daily basis? (month & year) _____

6. Do you currently smoke cigarettes, cigars, or a pipe on a less than daily basis?
____ yes ____ no

[If YES] 6a. What do you smoke? (Check all that apply.)

_____ cigarettes _____ cigars _____ bowls of tobacco

- 6b. On average, how often do you smoke? _____

6. How many alcoholic beverages do you drink per week (A 4 ounce glass of wine, 12 ounce beer, or shot of hard liquor each equal one drink)? _____

7. At least once a week, do you engage in any regular activity like brisk walking, jogging, bicycling, etc. long enough to work up a sweat or get your heart thumping? ____ yes ____ no

[If YES] 1a. How many times per week? ____ times per week

8. We are interested in the number of flights of stairs you climb UP on average each day. We only want to know the number of flights you climb going UP, not down. Let one flight equal 10 steps if you know the number of steps. ____ flights per day

9. How many city BLOCKS or their equivalent do you walk on average each day? We are only interested in walking done OUT OF DOORS. We do NOT want walking done around the house or at work. If you walk for exercise, report it in the table below, NOT here. Consider that 12 blocks equal 1 mile. ____ blocks per day

10. In the table below, please list any sports or recreational activities in which you participated during the PAST WEEK. These activities can include the activities mentioned in question number 1 above. We are interested only in the time you were physically active.

Sport or recreation during the past week	# of times the past week	Average time per episode	
		Hours	Minutes

11. During the past month, what time have you usually laid down to go to sleep?

Bed time: ____ AM / PM

12. During the past month, what time have you usually gotten up in the morning?

Getting up time: ____ AM / PM

13. On an average night during the past month, how long has it usually taken you to fall asleep after you laid down to go to sleep?

Minutes to fall asleep: _____ minutes

14. On an average night during the past month, how many minutes of sleep did you lose because you woke up in the middle of the night?

Minutes of sleep lost at night: _____ minutes

15. On an average night during the past month, how many minutes of sleep did you lose because you woke earlier than your usual time to get up?

Minutes of sleep lost in morning: _____ minutes

16. During the past month, how would you rate your sleeping quality overall?

_____ (1) very bad _____ (2) fairly bad _____ (3) fairly good _____ (4) very good

17. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?

_____ (1) never
_____ (2) less than once a week
_____ (3) once or twice a week
_____ (4) three or more times per week

18. During the past month, how often have you taken naps during the day?

_____ (1) never
_____ (2) less than once a week
_____ (3) once or twice a week
_____ (4) three or more times per wee

Appendix C

High Blood Pressure Feedback Form

Your results from this research indicate that you had **at least one blood pressure that was outside of the normal range** at some point during this study. This may have been a high blood pressure reading or a low blood pressure reading.

Because of this, **we strongly recommend that you take this information to your doctor or to the KU medical center.** There, a trained medical professional can tell you more about blood pressure and do a more thorough series of tests on you.

Your resting blood pressure for this study was _____

Your unusual reading for blood pressure was _____

If you would like, you can call from our office to the health center now & make an appointment.

The Watkins Health Center hours over the summer are:

Monday – Friday: 8:00 a.m. to 6:00 p.m.

Saturday: 12:00 p.m. to 4:00 p.m.

Sunday: Closed

Please call them at: 785.864.9500

They can also refer you to a specialist if you prefer to go to a doctor off-campus

For your convenience, below is information from the **American Heart Association** about what blood pressure is and what high blood pressure is.

What is blood pressure?

Blood pressure is the pressure of the blood against the walls of the arteries. Blood pressure results from two forces. One is created by the heart as it pumps blood into the arteries and through the circulatory system. The other is the force of the arteries as they resist the blood flow.

What do blood pressure numbers indicate?

The higher (systolic) number represents the pressure while the heart contracts to pump blood to the body.

The lower (diastolic) number represents the pressure when the heart relaxes between beats.

The systolic pressure is always stated first. For example: 118/76 (118 over 76); systolic = 118, diastolic = 76.

Blood pressure below 120 over 80 mmHg (millimeters of mercury) is considered optimal for adults. A systolic pressure of 120 to 139 mmHg or a diastolic pressure of 80 to 89 mmHg is considered "prehypertension" and needs to be watched carefully. A blood pressure reading of 140 over 90 or higher is considered elevated (high).

How can I tell if I have high blood pressure?

High blood pressure usually has no symptoms. In fact, many people have high blood pressure for years without knowing it. That's why it's called the "silent killer." Hypertension is the medical term for high blood pressure. It doesn't refer to being tense, nervous or hyperactive. You can be a calm, relaxed person and still have high blood pressure.

A single elevated blood pressure reading doesn't mean you have high blood pressure, but it's a sign that further observation is required. Ask your doctor how often to check it or have it checked. Certain diseases, such as kidney disease, can cause high blood pressure. In 90 to 95 percent of cases, the cause of high blood pressure is unknown.

The only way to find out if you have high blood pressure is to have your blood pressure checked. Your doctor or other qualified health professional should check your blood pressure at least once every two years, or more often if necessary.

Optimal blood pressure with respect to cardiovascular risk is less than 120/80 mm Hg. However, unusually low readings should be evaluated to rule out medical causes.

How can I tell if I have low blood pressure?

Blood pressure lower than 120/80 mm Hg is considered "normal," and the term "low blood pressure" is relative (there are no hard & fast rules about what is TOO low). Low blood pressure is generally considered dangerous when it drops suddenly or is accompanied by symptoms, such as dizziness or fainting. Severely low blood pressure can indicate serious heart, endocrine or neurological disorders and can deprive the brain and other vital organs of oxygen and nutrients, leading to shock, which can be a life-threatening condition.

Symptoms to watch for include:

- Dizziness or lightheadedness
- Fainting (called syncope)
- Lack of concentration
- Blurred vision
- Nausea
- Cold, clammy, pale skin
- Rapid, shallow breathing
- Fatigue
- Depression
- Unusual thirst

There is no specific number at which blood pressure is considered too low. Most doctors consider chronically low blood pressure dangerous only if it causes noticeable signs and symptoms. However, a sudden fall in blood pressure can be dangerous — even a change of just 20 mm Hg can cause dizziness or fainting. Some rapid falls in blood pressure indicate a deeper underlying problem such as uncontrolled bleeding, severe infections or allergic reaction.

Factors that can contribute to low blood pressure:

Pregnancy, Medications (heart medications, Parkinson's, antidepressants; Viagra®), **Heart problems, Endocrine problems** (hypothyroidism and hyperthyroidism, Addison's disease, low blood sugar, diabetes), **Dehydration, Severe infection, Allergic reaction, Postural hypotension** (In some people, blood pressure drops rapidly when standing from a sitting or prone position), **Nutritional deficiencies, and other problems.**

When to see the doctor

If you experience any dizziness or lightheadedness, you may want to see your doctor. If you have gotten dehydrated, have low blood sugar or spent too much time in the sun or a hot tub, how quickly your blood pressure drops is more important than how low it drops. Keep a record of your symptoms and your activities at the time your symptoms occurred.

Appendix D

Try to recall a time in your past when you felt sad.

Try to recall an event that you can remember vividly so that you can remember specific details of the situation. Take a moment to find that event in your memory. It can even be an event from several years ago, as long it is still vivid and still makes you sad to think about it.

Examples of memories include “the death of my younger brother in a motorcycle accident, my best friend ending our friendship, my mother calling me names, my boyfriend/girlfriend breaking up with me, or even a situation in which you felt helpless and alone”.

If it helps, you may close your eyes so that you can vividly recall this event. Once you have found the memory you will be focusing on, write a descriptive sentence or two about the life event you have chosen below and then go to the next segment once you have chosen an event.

Try to really intensely get into the feelings of the memory. Allow yourself to get into and develop a sad mood state that is intense and as real as you can possibly make it. While focusing on the sad feelings this event, please write in the space below what is going on in your mind in relation to this event. You may describe thoughts related to the event, people involved, where you were, other emotions that were present, what you were thinking at the time of the event and surrounding that time, how your body responded, or even the implication of the situation. Describe the event in a way that allows you to experience the intense sad emotions to the greatest extent. While completing this task, feel free to take moments to pause and reflect upon the event so that you can fully relive the experience.

Ideally, we would like you to continue to write for about 10 minutes, but if you run out of things to write just continue to think about the situation and re-live the experience as best as you can.

Emotional Regulation Instructions:

1. Observe and Describe Condition: Bring your awareness to the present moment and whatever thoughts, emotions and sensations you have, these can even be bodily sensations, write them down. Simply observe and describe whatever emotions, sensations, and thoughts attached to this painful circumstance, just labeling them for what they are. Whatever emotion, thought, or bodily sensation that comes up, just note it by writing it down and describing what it is that you are experiencing. For example, you may write “I notice that I feel sad, my heart is beating rapidly and I thought about this time when ...”

2. Acceptance Condition: Bring your awareness to the present moment and whatever thoughts, emotions and sensations you have, notice them and accept that it is perfectly normal that you are

experiencing them. There is no need to judge yourself for having any thought, emotion, or sensation. We naturally want to resist whatever emotions, sensations, or bodily sensations we are experiencing, but instead see if you can accept and fully experience the emotion without reacting or judging yourself for having it. Validate how hard it is to feel this but it is okay that you feel that way. See if you can allow the emotion to be there as it is. Simply write down what you are trying to accept and focus on not judging yourself. For example, you may write, “I accept that I feel... It is okay that I feel .. (or) It is normal that I feel...”

3. Changed Based Technique Condition: As you come up with a thought surrounding the situation you are thinking about, write down that thought, and then frame the thought in a new, alternative way. Examine the thought and see how accurate it is – mentally noting how the thought may be unrealistic or out of proportion and then reframing the thought. For example, if you think “I should have studied for that test longer, then I wouldn’t have failed.” you can change it by thinking of another way to view the situation, such as “There was no way I could’ve known what was on the test and I did the best I could have done.”

Appendix E

Table 1

Average raw data means and (SD) per condition and study time-point

DV Condition	Baseline	Stress	Coping	Recovery
RSA				
Observe/Describe	6.69 (1.18)	6.51 (1.01)	6.53 (0.91)	7.13 (1.05)
Accept/Non-Judge	6.82 (1.03)	6.51 (0.93)	6.64 (0.79)	7.00 (0.89)
Reappraise	7.06 (1.12)	6.68 (1.00)	6.91 (1.39)	7.17 (1.32)
SBP				
Observe/Describe	112.05 (12.00)	113.85 (12.20)	109.88 (11.22)	111.92 (11.68)
Accept/Non-Judge	108.10 (12.51)	110.59 (9.67)	109.74 (9.49)	107.57 (9.43)
Reappraise	109.50 (9.34)	110.63 (11.24)	109.03 (11.10)	110.02 (11.20)
DBP				
Observe/Describe	64.80 (6.48)	65.76 (5.51)	64.71 (6.93)	65.41 (6.74)
Accept/Non-Judge	64.16 (4.45)	65.16 (4.69)	64.08 (4.30)	64.20 (4.59)
Reappraise	64.53 (5.27)	64.68 (5.44)	63.70 (5.59)	64.41 (6.46)
HR				
Observe/Describe	68.95 (13.77)	74.68 (14.01)	71.59 (13.98)	66.72 (13.17)
Accept/Non-Judge	72.45 (11.50)	75.05 (12.77)	73.68 (12.45)	68.97 (11.35)
Reappraise	66.34 (10.55)	71.08 (12.51)	69.21 (8.93)	64.38 (10.21)

Table 2

ANOVA repeated measures summary of main effects for time displayed for each dependent variable

DV	F-value	P-value
RSA	16.61	0.00
SBP	6.98	0.00
DBP	3.06	0.05
HR	67.58	0.00